Vol. 104 No. 2590 THURSDAY JAN 11 1951 9d.

THE MODEL ENGINEER

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PERCIVAL MARSHALL & CO. LTD. 23, GREAT QUEEN ST., LONDON, W.C.2

11TH JANUARY 1951 VOL. 104 NO. 2590

SMOKE RINGS

Acknowledgments

● WE WOULD like to take this opportunity of acknowledging, with our most cordial thanks, the receipt of a very large number of letters and cards conveying seasonal greetings from readers. Needless to say, we heartily reciprocate these good wishes and we hope that all our readers may be able to indulge their model making without interruption in 1951. The immediate prospects do not appear to be very encouraging to any of us, and we can only hope that the clouds may clear and so disperse the threatening storm. What seems, to us, to be badly needed, is a far more widespread appreciation of the model engineering spirit; for we know that, where that spirit prevails and is properly understood, there can be no room for thoughts and threats of war with their attendant upheavals and dislocations of our normal lives.

2-mm. Scale Steam Possibilities?

● MR. A. A. SHERWOOD'S "OO"-gauge steam Mallet compound locomotive seems to have attracted the attention of several of our more experimentally-minded readers, who state that they intend to try their hands at something similar. We wish them luck in their efforts.

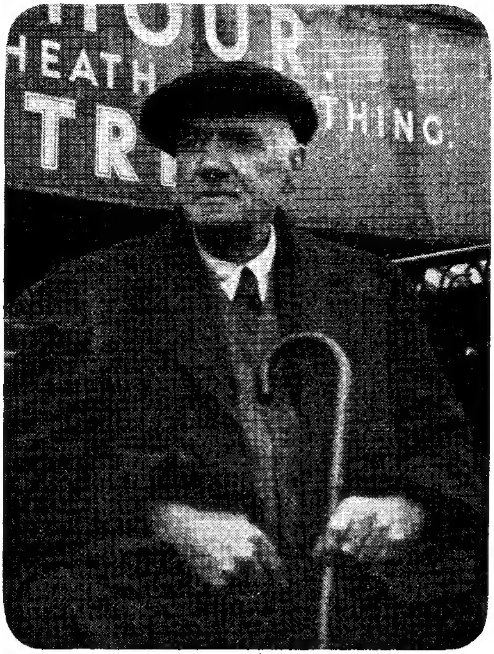
However, there are a very few readers who have been fascinated, for some time, in 2-mm. scale and are now inclined to give some consideration to producing microscopic steam engines in this very small size. We fancy that the problems to be solved will be the reverse of very small; but that, far from being a deterent, is usually the urge which acts as a spur to the experimenter who is determined to achieve success. We shall be most interested to learn, in due course, what results, if any, are forthcoming. We would suggest, however, that Mr. Sherwood's method of progress by way of lilliputian boat engines to locomotives might, in the end, be the best to follow.

Chichester S.M.E. Exhibition, 1951

● THE CHICHESTER and District Society of Model Engineers will be holding its annual exhibition this year for *two* weeks from Monday, February 12th next. The venue will be the Assembly Rooms, as usual, and the society is aiming at providing an even more attractive show than before. There will be the usual competition section, entry-forms for which are now available, and can be obtained from Mr. W. Pope, 7, Willowbed Drive, Chichester, Sussex.

The Bradbury Winter Memorial Challenge Cup

● OF ALL the celebrated enthusiasts who have become widely known in model engineering circles during the past fifty-five years, none has commanded more respect than the late Dr. John Bradbury Winter. As an amateur mechanic, Dr. Winter was outstanding; he took the keenest interest and pride in this side of his life's activities; he possessed a fertile brain and a consummate skill in devising and constructing elaborate mechanical devices; he was as much at home on the drawing-board as he was at the lathe, and no matter what he made, he showed himself to be an absolute master of the craft. In this way, his name has come to be recognised as a symbol of the very best in non-professional mechanical craftsmanship.



The Late Dr. J. Bradbury Winter

Among his famous models and inventions were: Scale models, superlative in accuracy and workmanship, one of them being the *Rocket*, mainly in silver, and another the *Como* in Brighton Museum; the Bonnikoen speedometer, a device for estimating the speed of Zeppelins from the ground; a "Congreve" clock; a chiming clock with a chime for each day of the week, and a perpetual interlocking calendar operated by miniature signal levers. His mechanical treasures shown at exhibitions were in a class of their own.

To those of us who were privileged to know Dr. Winter personally, he was a staunch friend, a firm if gentle critic, but one whose generous nature was ever ready to help and encourage those whose abilities fell below his own.

It is fitting, therefore, that the memory and influence of such a personality should not be allowed to fade into oblivion, and we are more than pleased to be able to announce that, through the efforts of a number of the doctor's personal friends, a new challenge cup has been made available, with a view to encouraging the best possible amateur craftsmanship in model engineering.

Dr. Winter was a life-long reader of THE MODEL ENGINEER, a valued contributor to its pages, a much-esteemed friend of the late Percival Marshall, as well as of many of the past and present staff of our company. What, therefore, could be more appropriate than that the new cup, which is to be known as the Bradbury Winter Memorial Challenge Cup, shall, subject to the discretion of the judges, be awarded annually at THE MODEL ENGINEER Exhibition to the most outstanding example of amateur mechanical craftsmanship entered in the competition section? A photograph of it is reproduced on our cover this week.

The $4\frac{3}{4}$-in. Gauge

● SEVERAL READERS have noticed that in the recent note (December 7th issue) about the new track belonging to the Golden Gate Live Steamers, of Oakland, California, U.S.A., the available gauges are stated to be $2\frac{1}{2}$-in., $3\frac{1}{2}$-in. and $4\frac{3}{4}$-in. and we are asked if we can explain why the 5-in. gauge is, presumably, not recognised by our American friends.

This is an old story which was fully debated some 20 years ago when the 5-in. gauge first came into use as a substitute for $4\frac{3}{4}$-in. gauge in Britain. The controversy centred round the then rapidly-growing desire to see *true-to-scale* locomotives built to 1-in. scale, but capable of giving trouble-free and lasting service as passenger-haulers, and matters came to a head when interest was directed towards old-time types for the purpose stated. One inch to the foot, is apparently, a delightfully simple unit to use, and $4\frac{3}{4}$ in. is a clear and finite dimension to which track can be laid; but many people have been surprised to discover how few British locomotive types can be reduced to these dimensions and give, at the same time, true-to-scale appearance, robust working parts and essential working clearances. We all know now that the problem was solved by the adoption of 5-in gauge and $1\frac{1}{16}$-in. scale, a combination which gives a more practical scale/gauge ratio to which almost any type of locomotive can be constructed to give satisfactory service and very nearly exact scale appearance.

The American locomotive does not present the same problems, due to the fact that its dimensions are larger, in all directions, than those of ours; so our American friends have never had any reason to find fault with the 1-in. scale on $4\frac{3}{4}$-in. gauge. The fact that the gauge is very slightly wide for the scale does not affect a miniature American locomotive to anything approaching the same extent as it does a British one, especially an old-timer. For example, the Brighton "Gladstone" Class would be very difficult to reproduce in 1-in. scale on $4\frac{3}{4}$-in. gauge; but, as everybody now knows, it is easily possible in $1\frac{1}{16}$-in. scale on 5-in. gauge.

A $\frac{3}{4}$-in. x $\frac{3}{4}$-in. Vertical Steam Engine

by H. W. R. Gosden

THIS engine was designed to satisfy certain definite requirements. (1) to be simple to build; (2) to be capable of working hard for long periods; (3) to be a good-looking "engineering" job; (4) to have a long working life without needing adjustment or overhaul.

Condition No. 1 precluded any difficult setting up for machining, No. 2 necessitated an efficient lubrication system, No. 3—well, "beauty is in the eye of the beholder"! and No. 4 meant adequate bearing surfaces.

It was desired to incorporate these features in a design of moderate weight, so that the complete engine would be suitable for boat propulsion, and the engine, as shown in the photographs, including a 6 oz. flywheel and the two lubricators, weighs 1 lb. 14 oz.

To satisfy condition No. 1, a design was evolved which enabled the majority of the parts to be machined by a simple chucking process, chucking pieces being provided wherever possible, and metal patterns were made for all parts which were to be cast, except the standard, for which a wooden pattern and corebox were used.

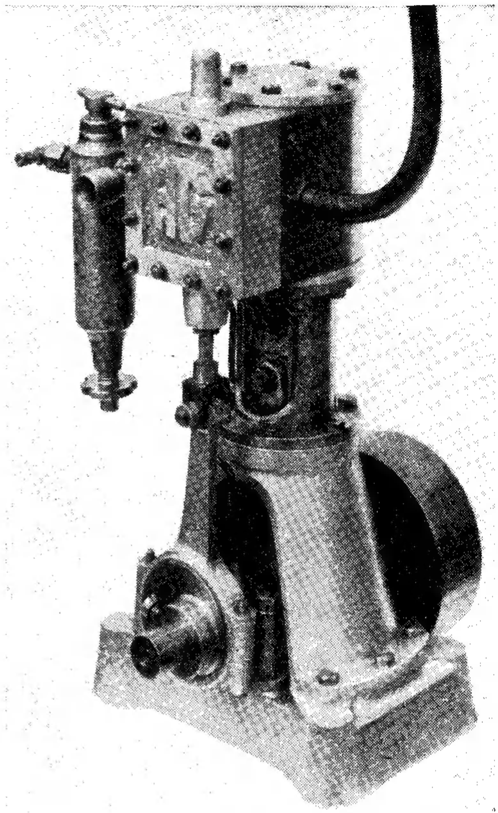
From the outset it was decided that sturdiness and light weight could best be achieved by the use of aluminium alloys wherever possible, and by using these for the reciprocating parts a satisfactory lack of vibration in running has resulted. The engine can be held in the hand quite comfortably when running at 4,500 r.p.m., and it will "tick over" smoothly down to a very low speed.

A local foundry produced some nice clean castings; the cylinder in gunmetal, the flywheel in cast-iron, all other castings being aluminium alloy.

The trunk guide and the crankshaft are built up from steel, and the parts brazed together, the trunk guide being a piece of 16-gauge steel tube, $\frac{7}{8}$ in. diameter, and two steel washers, $\frac{1}{8}$ in. thick. The lower end of the tube projects through the washer $\frac{1}{4}$ in., to register in the main standard.

The crank webs are cut to shape from $\frac{3}{16}$ in. × $1\frac{1}{4}$ in. bright mild-steel, drilled and reamed $\frac{3}{8}$ in. for the crankshaft and crankpin. The crankpin is centred and drilled through $\frac{1}{4}$ in. before assembly, to assist balance.

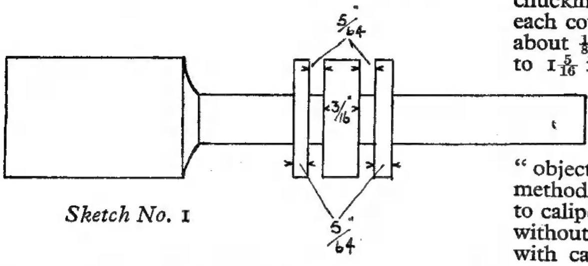
To proceed with the machining. The cylinder may be held in a four-jaw chuck, or clamped to an angle-plate mounted on the faceplate. In the latter case it is advisable to "saddle" a piece of wood roughly to fit the body of the cylinder casting between the flanges. A metal bar over this, held down by two bolts through the angle-plate will hold everything secure, and will reduce the possibility of distorting the casting whilst it is being machined. Set up in this manner, the end can be faced, and the cylinder bored and reamed, leaving the minimum amount for the reamer to remove. The faced end should be



marked, and kept to the bottom when assembling, in case of any slight inaccuracy when machining the other end, which can best be done by mounting the cylinder on a stub mandrel held in the chuck. The next operation is to bolt the cylinder to the angle-plate with a single bolt through the bore to machine the port face. This face is $\frac{3}{4}$ in. from the centre of the bore, and this can be marked on the end face before bolting the cylinder to the angle-plate. Be careful to keep the sides of the cylinder square with the faceplate—check with a steel square when setting up. Get this port face as truly flat and to the finest finish you can manage, then a few rubs on a piece of fine emery cloth resting on a surface-plate, piece of plate glass, or the lathe bed, will complete the job.

The steam and exhaust ports may be cut by one of several methods, the choice depending on the skill of the builder and the equipment he possesses. The ports may be marked-out on the port face, a row of five 5/64 in. holes drilled for the steam ports, and two $\frac{3}{16}$ in. holes

touching the ends of the exhaust port with two 5/64 in. holes side by side between them, all holes being no more than $\frac{3}{16}$ in. deep. The ports may then be trimmed to shape with tiny cold chisels—this is where the skill comes in! An alternative method is to mill the ports with end mills, slot drills, or dental burrs, but personally I do not have much luck with these, and on my



Sketch No. 1

engine the parts were cut with a ganged milling cutter. This sounds like a tricky piece of tool-making, but it is really nothing of the sort. A piece of $\frac{5}{8}$ in. round mild-steel, about 3 in. long, was centred with a Slocombe drill at each end and mounted between centres whilst a light cut was taken over a length of $2\frac{1}{4}$ in. to true up the periphery. A length of 1 in. was further reduced to $\frac{1}{2}$ in. diameter, then a small parting tool was ground to an exact width of 5/64 in. at the cutting edge, and two cuts made to leave a disc 5/64 in. thick next to the reduced end, then a $\frac{3}{16}$ in. disc. These cuts were carried in to leave a diameter of $\frac{1}{4}$ in. in the centre. The blank was further reduced for about $\frac{1}{2}$ in. to $\frac{1}{4}$ in. diameter, leaving another disc 5/64 in. thick. The blank will then appear as in sketch No. 1, and is removed from the lathe for cutting the teeth. This is quite easily done with a small half-round or knife-edge file, but remember which way it will rotate when in use! The number of teeth is unimportant—my cutter has 13—and uneven spacing is no disadvantage. Cut the teeth to leave a land about 1/32 in. wide at the top, and having cut them, give the cutter a good soaking in "Casenit" or some similar case-hardening powder. After quenching, give the lands at the top of the teeth a very small amount of "backing-off" with a carborundum slip. Some of you may hold up your hands in horror at the thought of mild-steel cutters, but the fact remains that they are easy to make, and stand up very well to the usual "one-off" (or several off!) jobs.

Replace the cutter in the lathe between centres, hold the cylinder in a vice on the vertical slide, or under the toolpost—if there is sufficient height available—feed in on the cross-slide until the ports are the correct lengh, according to the drawing, and lo! your ports are cut, neatly and accurately.

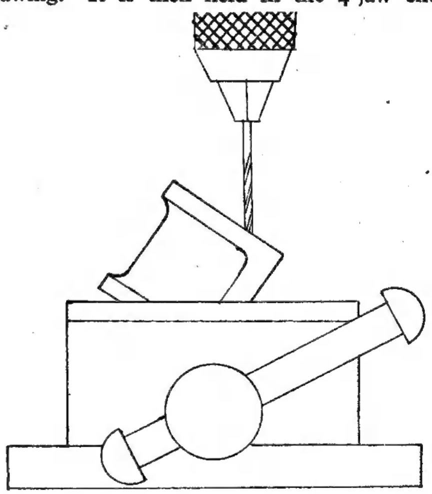
Steam passages consist of two 3/32 in. holes drilled at an angle from a small bevel filed at each end of the cylinder. If the cylinder is held in a machine vice on the drilling machine table, the angle can be set quite accurately by sighting the drill against the outside of the cylinder, as in sketch No. 2.

The exhaust passage is simply a 7/32 in. hole drilled in from the side, and tapped $\frac{1}{4}$ in. × 40 t.p.i. for the exhaust pipe to enter.

File or machine the cylinder casting to a width of $1\frac{1}{4}$ in., and trim the flanges to $\frac{5}{8}$ in. radius. This completes the cylinder, except for the cover fixing screw holes, and steam chest stud holes, which may be left for the moment.

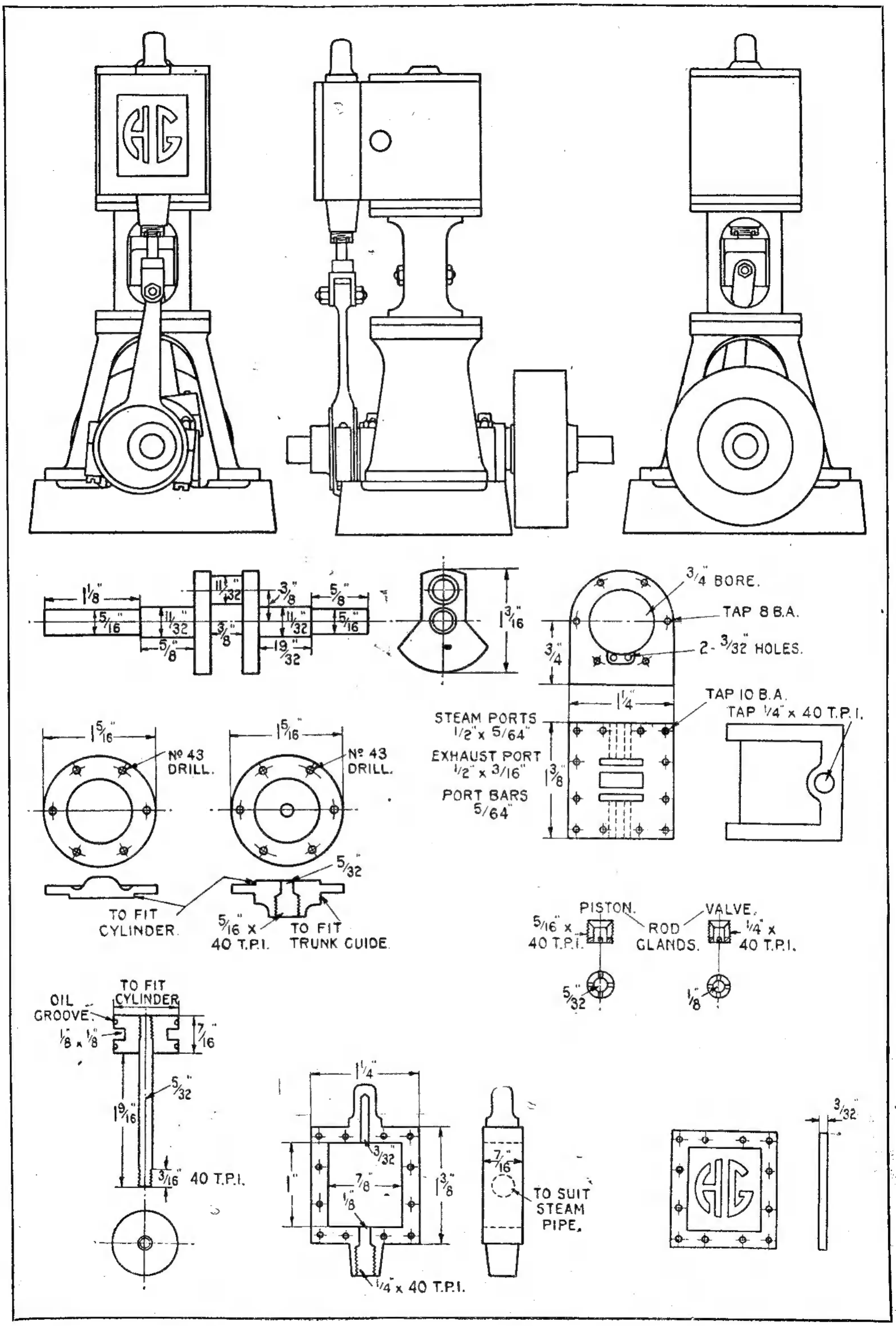
Cylinder covers are a straightforward machining job which can be done at one setting, a chucking piece being provided on the inside of each cover. If this is gripped in the chuck with about $\frac{1}{8}$ in. protruding, the cover can be turned to $1\frac{5}{16}$ in. diameter, the top face machined (in the case of the top cover), and a parting tool used to face the joint surface, turn the spigot, face the spigot to length, and part off. The only "objection" that may be raised against this method is that it is necessary to turn the spigot to caliper size—it cannot be tried in the cylinder without removing from the chuck. Of course, with care, and by marking the chucking piece so that it goes back in exactly the same position in the chuck, the "trial and error" method may be used.

The bottom cover is machined in the same way, except that the spigot engaging the trunk guide may be turned to fit this part, and the stuffing-box centred, drilled through 5/32 in., enlarged to 9/32 in. for $\frac{1}{4}$ in. depth, and tapped $\frac{5}{16}$ in. × 40 t.p.i. If a little care is taken, and the whole of this machining done at one setting, you are *sure* of concentricity and consequent free running. The valve chest first needs filing out internally to the dimensions in the drawing. It is then held in the 4-jaw chuck



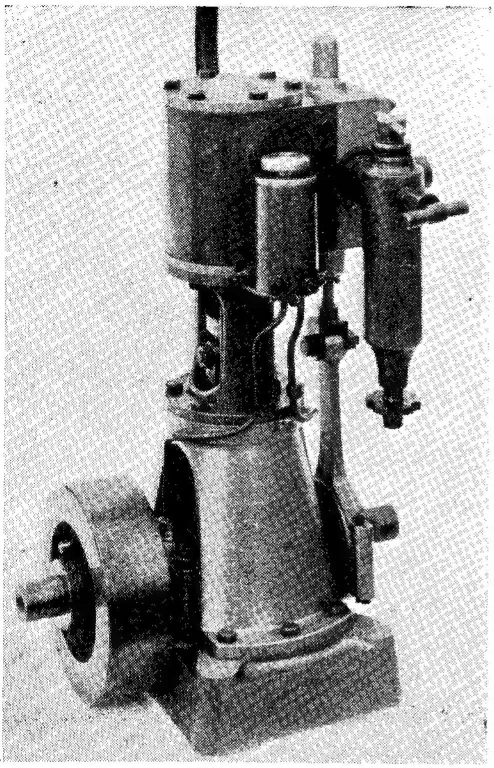
Sketch No. 2

for machining the joint faces—take care to keep them parallel—then clamped to an angle plate, on the faceplate, the sides machined to width, and the top end faced and extension guide turned. The bottom end is machined in the same manner, using a steel square against the faceplate, and the machined side when setting up, and at the same setting the valve-rod stuffing-box is centred and drilled through $\frac{1}{8}$ in. Continue to feed the drill through until it touches the opposite end of the valve-chest, then *very lightly*, so that the drill is


1⅛"
5/16"
11/32"
5/8"
3/8"
11/32"
3/8"
11/32"
19/32"
5/8"
5/16"
1 3/16"
3/4" BORE.
TAP 8 B.A.
3/4"
2- 3/32" HOLES.
1¼"
TAP 10 B.A.
TAP ¼" x 40 T.P.I.
STEAM PORTS 1/2" x 5/64"
EXHAUST PORT 1/2" x 3/16"
PORT BARS 5/64"
1⅜"
1 5/16"
No 43 DRILL.
1 5/16"
No 43 DRILL.
5/32"
TO FIT CYLINDER.
5/16" x 40 T.P.I.
TO FIT TRUNK GUIDE.
PISTON.
VALVE.
5/16" x 40 T.P.I.
ROD GLANDS.
¼" x 40 T.P.I.
5/32"
1/8"
TO FIT CYLINDER
OIL GROOVE
1/8" x 1/8"
7/16"
5/32"
1 9/16"
3/16" 40 T.P.I.
1¼"
3/32"
1"
7/8"
1/8"
1⅜"
¼" x 40 T.P.I.
7/16"
TO SUIT STEAM PIPE.
3/32"

not forced out of centre, feed in to get a good centre. Replace the $\frac{1}{8}$ in. drill with a 3/32 in., and drill $\frac{9}{16}$ in. deep. Enlarge the hole in the stuffing-box to 7/32 in. for a depth of $\frac{5}{16}$ in., and tap out $\frac{1}{4}$ in. $\times$ 40 t.p.i.

Mark out and drill the stud holes in the valve-chest with a No. 50 drill. The valve-chest may



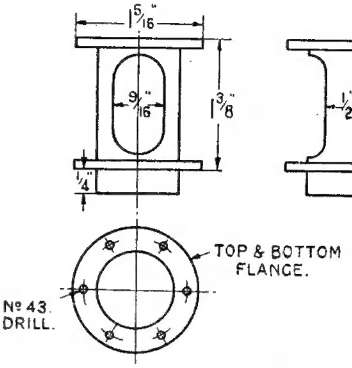
then be clamped to the cylinder, and a No. 50 drill used to mark the stud hole positions which are then drilled No. 55 and tapped 10 B.A.

The valve-chest cover, provided with a chucking piece on the "inside," is another single setting job. Held in the 3-jaw chuck, the cover is faced front and back, and parted off. The stud holes are drilled, using the steam chest for a jig, and the four sides of the cover filed to suit the valve-chest.

A hole is drilled and tapped in the side of the valve-chest to take a displacement lubricator, with a right-angled union for the steam pipe. This hole is drilled 7/32 in. and tapped $\frac{1}{4}$ in. $\times$40 t.p.i.

Glands for piston and valve-rods are very simply made from gunmetal or brass rod. Chuck a piece of rod, face, centre deeply with a Slocombe and drill through 5/32 in. or $\frac{1}{8}$ in. as required. Turn down the outside to $\frac{5}{16}$ in. or $\frac{1}{4}$ in., and, using a tailstock die-holder, thread 40 t.p.i. Part off to $\frac{1}{4}$ in. length, cross-slot the "outside" end (not the countersunk end!) for a key, and they are finished. For the cross-slotting, either drill and tap a hole in a piece of brass rod, and screw in the gland, or hold the gland in the die used to cut the thread. Slot with a hacksaw and trim up with a file.

Make the piston-rod before you machine the piston. It is a 2 in. length of 5/32 in. stainless steel, screwed 40 t.p.i. for $\frac{3}{16}$ in. at one end, and $\frac{1}{4}$ in. at the other.



The piston is provided with a chucking piece which may be held in the 3-jaw chuck, the piston turned oversize and faced, centred, drilled $\frac{1}{8}$ in. about $\frac{3}{8}$ in. deep, enlarged to 5/32 in. for $\frac{3}{16}$ in. depth, and tapped 5/32 in. $\times$ 40 t.p.i. Hold the piston-rod in the tailstock drill chuck, with the $\frac{1}{4}$ in. screwed end towards the piston, and screw it home tightly. This should leave $1\frac{9}{16}$ in. projecting. Release the tailstock chuck, and spin the mandrel to see if the piston-rod runs true—it should, but it may not! If it does, carry on and finish machining the piston to a nice sliding fit in the cylinder, after turning the packing groove and two small oil grooves. If your luck is out and the rod wobbles, turn the packing groove, part off the piston to length, and finish turning with the piston-rod held in a brass bush in the 3-jaw chuck. If a piece of $\frac{1}{4}$ in. brass-rod is used for this, faced, centred and drilled through 5/32 in., the piston-rod may be placed in it, and if the jaws of the chuck are tightened fairly firmly, the rod will be truly held. Finish turn as before.

When fitting the rod to the piston, it may be found that rather more than $1\frac{9}{16}$ in. projects. If it does, run the 40 t.p.i. die on to obtain the required $1\frac{3}{8}$ in. of plain rod, and trim the rod to length after parting off the piston. This length is rather important, as there is not a lot of clearance to spare between the gland and the crosshead.

The trunk guide does not call for very much machining. The bore is quite sufficiently true, and merely requires polishing on a simple lap to remove the scale which occurs in brazing. The machining may then best be done on a mandrel. The flanges are turned to diameter, faced to length, cleaned up on the inner faces, and the centre of the guide and the spigot lightly skimmed to clean up. The openings in the sides of the guide are produced by filing. A round file at the ends gives the correct "run-out" and a square or flat file takes away the portion in the middle.

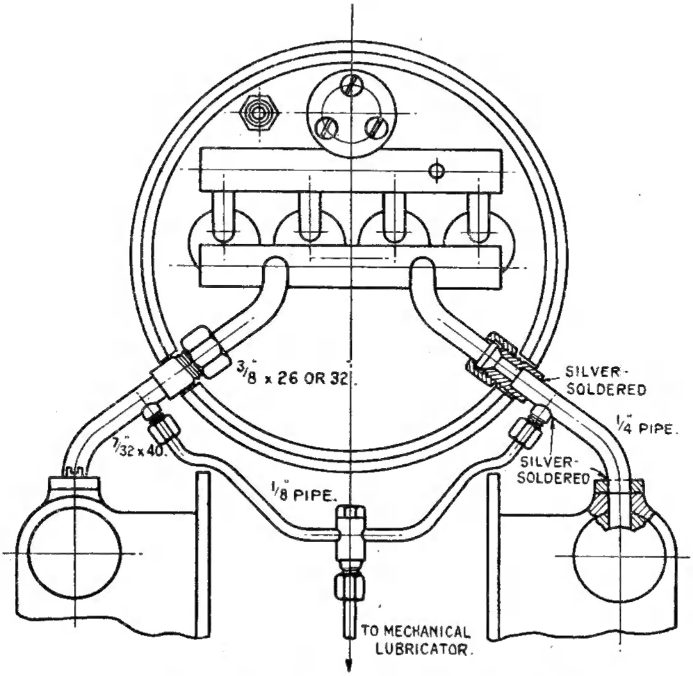
(To be continued)

"PAMELA" by "L.B.S.C."

A 3½-in. Gauge Rebuild of a Southern Pacific

THE steam-pipe connections on our little "rebuild" will naturally be far simpler than on the original full-sized engines; another item that gave no end of trouble! In our case, we have already fitted two ¼-in. pipes, with union nuts and cones, to the hot header of the superheater; so all we have to do, is to connect these to the cylinders by means of two short pipes with a union screw at the upper end, and a flange at the bottom, for attachment to the oval flange on top of the steam-chest. The whole arrangement is shown clearly in the accompanying illustration, which also shows how the oil supply from the mechanical lubricator is introduced into the flow of hot steam where it is atomised, and the spray is carried to the valves and pistons, ensuring that every moving part gets its fair share.

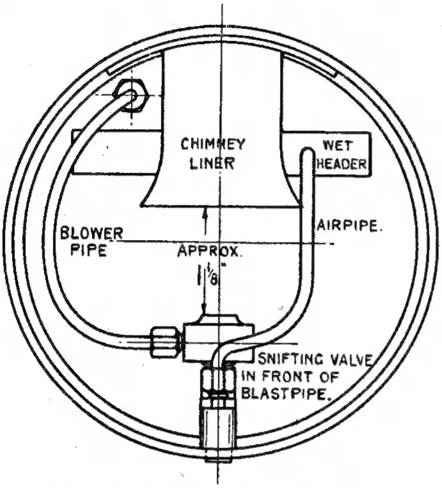
The first item is to drill two ⅛-in. or No. 30 pilot holes in the smokebox barrel, in line with the steam holes in the middle of the oval seatings on top of the steam-chests, and approximately 15/16 in. above the bottom of the smokebox barrel, measured vertically. This will be near enough 1⅛ in. above the surface of the seatings. Open these out with a 19/64-in. drill, and ream 5/16 in., so that a piece of 5/16-in. round rod will just slide in. Chuck a piece of 5/16-in. round brass rod in three-jaw; face, centre deeply, drill down about ¾ in. depth with 5/32-in. drill, screw ¼ in. of the outside 5/16 in. × 32 or 26, to match the union nuts in the smokebox, and part off at ⅝ in. from the end. Reverse in chuck, and open out with letter D drill for ¼ in. depth. Use ¼-in. drill if letter D isn't available, the latter is drive fit for the ¼-in. pipe; then repeat operations. The two flanges for attaching to the steam-chest seatings, are sawn and filed from a piece of ⅛-in. brass plate, a simple job requiring no detailing. Use letter D drill for the pipe hole if available. Rub the flanges on a smooth file laid on the bench, to get one side of each true.



Steam and oil pipe connections to cylinders

Cut two pieces of ¼-in. copper pipe to a length of 1¾ in., and drive a flange on one end, and a union screw on the other. At about 3/16 in. from the end of the union screw, drill a 5/32-in. hole in the pipe; and in it, fit a little union screw, 7/32 in. × 40, exactly the same as the one in the check-valve under the mechanical lubricator. Note, these must be set at right-angles to the oval flanges. The whole lot can then be silver-soldered at one heat, using best grade silver-solder, or "Easyflo." Pickle, wash off, and clean up, and then bend the pipes to the shape shown in the illustration. If a piece of rod is pushed into

each end, sufficient leverage is easily obtained to do the bending by finger pressure only, and avoid any risk of kinking the pipes. The amount of bending required, is ascertained from the actual job; the flange should seat nicely on the steam-chest, when the union is pushed into the hole in the smokebox. All that remains, is to connect up the union nuts on the superheater pipes, to



Blower and snifting valve connections

the union fittings on the ends of the outside pipes, and attach the flanges to the seatings on the steam-chest by a couple of $\frac{1}{8}$-in. or 5-B.A. screws. Put a 1/64-in. Hallite or similar jointing gasket between flange and seating.

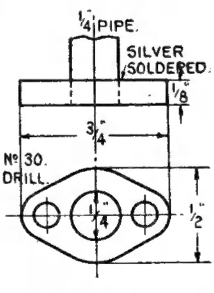
Oil Check Valve and Pipes

If the check-valve under the mechanical lubricator is O.K. there really shouldn't be any need for an extra clack or check-valve on the delivery pipe; but unfortunately, it sometimes happens that a tiny bit of grit, smokebox ash, or some other non-lubricant, somehow finds its way to the ball seating—if you *wanted* such a thing to happen, it just *wouldn't*!—and allows steam to get into the oil tank. The extra clack is insurance against this, and I always fit one. Chuck a piece of $\frac{5}{16}$-in. round rod in the three-jaw (brass will do if nothing better is available), face the end, and centre deeply. Turn down $\frac{1}{4}$ in. of the end to 7/32 in. diameter, and screw 7/32 in. × 40. Part off at $\frac{11}{16}$ in. from the end. Reverse in chuck; centre, and drill right through with No. 44 drill. Open out and bottom to $\frac{3}{8}$ in. depth with $\frac{3}{16}$-in. drill and D-bit, tap 7/32 in. × 40, and fit a ball, spring and cap exactly as described for the lubricator check. The ball seat is reamed 3/32 in.; or if you haven't a reamer that size, true it with a taper broach.

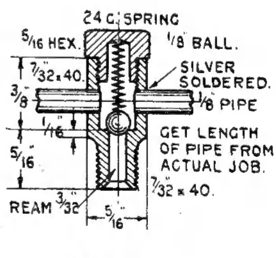
Temporarily remove ball and spring, and at $\frac{3}{16}$ in. from the top, drill a No. 32 hole clean through both sides. Fit a piece of $\frac{1}{8}$-in. copper pipe, approximately $2\frac{1}{4}$ in. long, in each hole. On the other ends of the pipes, fit 7/32 in. × 40 union nuts and cones, and then silver-solder all the joints at one heating, softening the pipes at the same time. Pickle, wash off, and clean up; replace ball and spring, screw the cap on tightly, then couple up the union nuts to the union screws on the steam pipes, as shown in the illustration. The pipes are easily bent to clear the frames, by finger pressure only. Finally, couple up the bottom of the check valve, to its mate on the underside of the lubricator, by a piece of $\frac{1}{8}$-in. copper pipe with a 7/32 in. × 40 union nut and cone on each.

Finishing off the Front

I have already dealt with fitting up the snifting-valve, etc., but thought—to paraphrase a line of a once-popular song—"another little sketch wouldn't do us any harm," so included one showing the snifting-valve and blower pipe connected up. The approximate distance between the top of the blastpipe cap and the bottom of the liner, is $1\frac{1}{8}$ in., but a shade more or less won't make any difference. Put a bit of round silver-steel, which is usually very straight, down the hole in the cap; it should be a nice sliding fit. If it doesn't stand up exactly in the middle of the liner, bend the blastpipe until it does. Then put a taper broach down the liner, holding it exactly in the middle, and take just a scrape out of the hole, to give it just a weeny bit of taper. This spreads the jet of exhaust steam, and makes for better draught with the minimum of back pressure. Put a smear of plumbers' jointing (Boss White or similar; a mixture of red lead and gold size or boiled oil can be used at a pinch) around the inside edge of the smokebox shell; then press the ring in. A bit of hard wood held against the edge, and tapped with a hammer, is a fine persuader. The ring should enter until only just the rounded-off edge is showing; no further fixing is required, or even desirable, as the front may need removing at some future time. Make sure the door hinges are horizontal. Any interstices around the pipes, where they pass through the holes in the smokebox shell, may be



Steam pipe flange

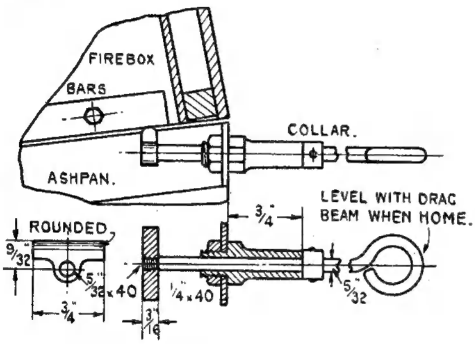


Oil check valve

sealed either with fireproof "putty" made by kneading up scraps of asbestos millboard with a little water, or with a few strands of asbestos string treated with plumbers' jointing. Pump some air into the boiler, with a tyre-pump; hold a lighted taper against the firehole, and open the blower valve. If the flame is sucked into the firehole, you can reckon that the smokebox is airtight, and the blast nozzle and blower all O.K.

Support for Drop Grate

The simplest way of holding up the centre part of the grate, whilst the engine is at work, is by a push-pin running through a bearing screwed into the closed-in upper part of the ashpan back. My own engines with dump grates working in similar manner, have this arrangement, but with a knob on the end of the rod. The ring is handier for *Pamela*, as there is a space between footboard and drag-beam, in which the ring can lie flat, out of the way. Drill a $\frac{1}{4}$-in. clearing hole in the centre of the ashpan back, about $\frac{5}{16}$ in. from the top. Chuck a bit of $\frac{3}{8}$-in. hexagon brass rod in three-jaw, face the end, turn down $\frac{5}{8}$ in. length to $\frac{1}{4}$ in. diameter, and part off 1 in. from the end. Reverse in chuck, centre, and drill a No. 22 or 5/32-in. hole right through; turn down $\frac{1}{4}$ in. of the end to $\frac{1}{4}$ in. diameter, screw $\frac{1}{4}$ in. × 40, and make a nut to suit. Push screwed the end through the hole in the ashpan back, and nut up tightly.



Support for drop part of grate

Bend the end of a piece of 5/32-in. round steel rod into a ring. Poke it through the bearing until the ring is over the top of the drag-beam, clear of the edge; then mark a point on it $\frac{5}{8}$ in. beyond the screwed end of the bearing. Remove it, cut off, and screw 5/32 in. × 40. File up a T-head from a bit of $\frac{3}{16}$ in. × $\frac{1}{2}$ in. steel bar, to the shape shown; round off the top, and drill and tap a 5/32 in. × 40 hole in the lug. Make a little collar by parting off a piece of $\frac{1}{4}$-in. rod about $\frac{3}{16}$ in. long, and drilling a No. 23 hole through it. Drive this on to the pin, so that it is $1\frac{5}{8}$ in. from the screwed end; if it won't "stay put," pin it. Put the end of the long pin through the bearing, hold the T-head under the firebars, and screw the pin home tightly, so that when the T-head is bearing on the underside of the bars, the ring lies flat. When the enginemen's footboard is in position, the ring will lie between it and the top of the drag-beam; and to dump the grate, all you do is to hook it out with a bent bit of wire, if your fingers are too big to go in the space. The movable part of the grate will drop down in the ashpan hopper as soon as the T-head is clear of the bars. To replace, push up the grate with the fireman's pricker or dart, and push the pin back again. The collar prevents it going in too far, and the friction of the rod in the bearing, and pressure of bars on the head, will keep it in position; or if a positive fixing is required, file a shallow groove under the bars, where the T-head touches them.

Injector

The injector for *Pamela* is of my "standard" type, which has been fully described in these notes "many a time and oft," so there is no need to give a long dissertation on it. A similar type, with side entrance for water, is described in the *Live Steam Book*. With a normal fire, it will feed the boiler, running or standing, without appreciable effect on the steam pressure, which is something that none of the ordinary commercial injectors has so far managed to do. The following short description should enable anybody to make one. First make the reamers for the cones, from pieces of 5/32-in. round silver-steel; each should be about $2\frac{1}{2}$ in. long. Turn a taper on each, to lengths of $\frac{3}{4}$ in., $1\frac{1}{8}$ in., and $\frac{3}{16}$ in. respectively; the first two are straight tapers, but the stubby merchant is slightly concave. File away half the diameter of each taper, harden and temper to dark yellow, and give the flats a final rub-up on a fine oilstone.

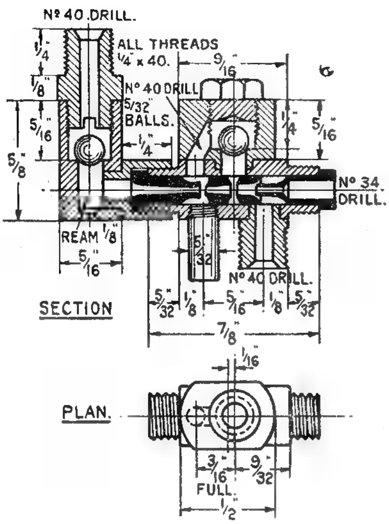
The body is made from a piece of $\frac{5}{16}$-in. square brass rod parted off, or sawn and faced each end, to a length of $\frac{7}{8}$ in. Chuck truly in four-jaw, centre, drill through with No. 23 drill, and ream 5/32 in. Turn down 5/32 in. of the end to $\frac{1}{4}$ in. diameter, and screw $\frac{1}{4}$ in. × 40. Reverse in chuck, and repeat the turning and screwing operation; beginners note that if jaws No. 1 and 2 are slacked, the piece of rod reversed, and the same two tightened again, the rod will still run truly. On one of the facets, which will form the top of the injector body, drill a $\frac{1}{8}$-in. or No. 30 hole in the middle, and counterbore it to a depth of $\frac{1}{16}$ in. bare, with a $\frac{3}{16}$-in. pin drill. At a full $\frac{3}{16}$ in. away from this, drill a No. 40 hole; both this hole, and the $\frac{3}{16}$ in. counterbore, are shown dotted in the plan view. On the opposite facet, which will form the bottom of the injector, at $\frac{1}{8}$ in. from the shoulder, drill a No. 30 hole, and tap it 5/32 in. × 40 for the overflow pipe. This hole is at the same end as the No. 40 hole mentioned directly above. At $\frac{1}{8}$ in. from the other end, drill a 5/32-in. hole, and fit a $\frac{1}{4}$ in. × 40 union screw into it.

Part off a $\frac{3}{8}$-in. length of $\frac{1}{2}$-in. round brass rod, and make a centre-pipe on it, $\frac{1}{16}$ in. from the true centre indicated by the tool marks. Chuck in four-jaw with this pop mark running truly; open it out with a centre drill, then drill right through with No. 34. Open out and bottom with 7/32-in. drill and D-bit, ream the remains of the No. 34 hole with $\frac{1}{8}$-in. reamer, then at $\frac{3}{16}$ in. from the centre of the reamed hole, on the wider side, drill a No. 40 hole slantwise into the tapped hole, as shown in the section. Be careful to avoid damaging the ball seat. Chuck any odd bit of brass rod about $\frac{3}{8}$ in. diameter, in the three-jaw, turn down $\frac{1}{8}$ in. of the end to $\frac{1}{4}$ in. diameter, and screw it $\frac{1}{4}$ in. × 40. Screw the fitting on to this, and turn down $\frac{1}{16}$ in. of the end, to a tight fit in the counterbored hole in the injector body. Squeeze it in so that the No. 40 hole in it, and the one in the body, line up as shown; then silver-solder the joint, and the union screw underneath, at the same time. Pickle, wash off, and clean up,

then fit a ball and cap as shown, same as for a clackbox (already described) and run the 5/32-in. reamer through the body again, to remove any burrs.

Cones

Cones, to judge from my correspondence, are the *pons asinorum* of abour 80 per cent. of the



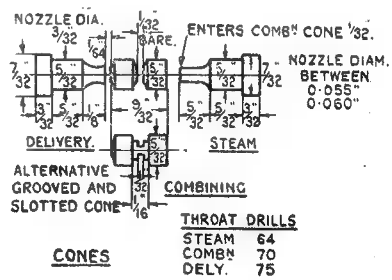
Injector details

good folk who have written me on the subject of injector failures; and the irony of it is, they needn't be! Oversize throats, wrong tapers, and bad fits are merely matters of indifferent workmanship, easily avoided by a little care, patience and perseverance. Broken drills form the basis of more tales of woe. For beginners' benefit, may I repeat that weeny drills won't break if you feed steadily, *and withdraw at every $\frac{1}{16}$ in., or less*, and clear the chips from the flutes. It is choking of the flutes that causes seizure and breakage. I'm not infallible; I break a drill now and again, same as any other human being, but it is very seldom. Also don't forget, that the smaller the drill, the higher the speed required.

Make the combining cone first. Two varieties are shown; the first is quicker on the "pick-up," but the second is easier to make. In full size, they are known as the Holden and Brooke, and the Sellers, respectively. It must be a press fit in the body; and all you have to do, to get this O.K., is to ream the steam end of the body, very slightly, with a taper broach, so that for the first $\frac{1}{16}$ in. or so, the hole is about a thousandth of an inch larger in diameter. Chuck a bit of $\frac{3}{16}$-in. round brass rod in three-jaw, and turn down about $\frac{3}{8}$ in. of it until it will just enter the enlarged end of the hole the weeniest bit; it is then a press-fit for the rest. Simple enough, isn't it? Face, centre, and drill $\frac{5}{16}$ in. depth with No. 72 drill and form the end to a very blunt nose, as shown in the illustrations. Part off 9/32-in. from the end. Reverse in chuck, and ream with the $\frac{3}{4}$-in. taper reamer until the point comes through about 1/32 in. I use a brass sleeve made from $\frac{5}{16}$-in. rod 1 in. long, with a 3/32-in. set-screw in it, on the reamer shank, to act as a stop. Slightly countersink the end with the stubby reamer. For the divided cone, hold the piece in the three-jaw with half projecting; saw across with a jeweller's saw, or very thin hacksaw, and true up each half by just removing the saw marks and slightly cutting back, as shown in the illustrations. The larger end of the hole in the smaller half should be very slightly radiused. For the slotted cone, turn a $\frac{1}{16}$-in. groove in the middle, with a parting tool, and file two 1/32-in. slots breaking into the tapered hole.

Press the smaller-holed half of the cone, nozzle first, into the body, using the vice as press, and a bit of rod, countersunk at the end, and a shade under 5/32 in. diameter, as a "ramrod"; the end of it should just go past the middle of the hole in the bottom of the ball chamber. Now put a sliver of metal, a shade under 1/32 in. thick, down the hole, and press in the second half until the leading end just touches the bit of metal and holds it very lightly against the front half. Carefully extract the sliver, and Bob's your uncle as far as that job is concerned. So darned easy—and yet I've seen "injectors" with cones drilled "all over the shop," spaced anyhow, and soldered in; and the makers wonder why they don't work! The slotted cone is simply pressed in until the slot is under the hole in the ball chamber.

Chuck a bit of 7/32-in. round brass rod in three-jaw, and turn it down until it is a tight push fit in the delivery end of the injector, and reaches to within 1/64 in. of the nozzle of the combining cone. Turn the outside to the shape shown; then centre (I use a broken dental burr ground to a tiny arrow point for cone centring) and drill down with a No. 76 drill, to the depth of the flutes. Open the end with the stubby reamer,

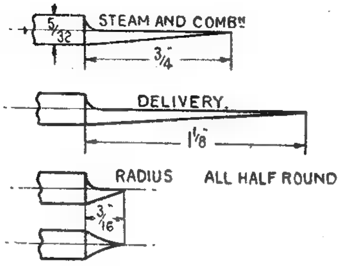


Details of cones

almost to a knife edge. Part off to leave a 3/32-in. flange. Reverse in chuck, centre the other end, drill with a No. 60 or thereabouts until you meet the 76 hole, then ream with the $1\frac{1}{8}$-in. taper reamer until the point just comes through into the countersunk end. If you set the stop sleeve at $\frac{5}{16}$ in. from the reamer point, it should be about right. Slightly bell the end with the stubby reamer. That settles the delivery cone.

For the steam cone, chuck the 7/32-in. rod again, and turn down the end to a tight push-fit, and of such a length that when pushed in against the end of the combining cone, the shoulder is a

bare 1/32 in. from the injector body. I use a bit of broken 23-gauge hacksaw blade to get this right ; it should go tightly between shoulder and body. Centre, and drill to $\frac{7}{16}$ in. depth with No. 66 drill. Turn the outside to shape shown ; the outside diameter of the nozzle should be between 0.055 in. and 0.060 in., but if you have no "mike," it is easily gauged with calipers, setting them to $\frac{1}{16}$ in. and letting them slide over easily. Otherwise, drill a $\frac{1}{16}$-in. hole in a bit of metal, and use that as a gauge. Now put the



Cone reamers

$\frac{3}{4}$-in. taper reamer in, and ream the end almost to a knife-edge. Part off to leave a 3/32-in. shoulder, same as the delivery cone. Reverse in chuck, and drill out the back to $\frac{1}{4}$ in. depth with No. 34 drill. This cone can be "sized" right away. Put the $\frac{3}{4}$-in. taper reamer down the drill hole, and take a scrape out of the little hole at the bottom ; then try a No. 64 drill in it. If it won't go through, take another scrape out, and try again, "ditto repeatoing" until the 64 drill just sticks. Then put the 64 drill in a pin-chuck, poke it down the hole again and give it a twirl between thumb and finger. It will then go through, and you will have a steam cone with a No. 64 throat, dead to size.

Put the longer taper reamer down the back of the delivery cone, and play the same merry game until you can just twirl a 75 drill through the throat. Then poke the $\frac{3}{4}$-in. taper one through the combining cone, in place in the body, and scrape that out until a No. 70 goes through the end. Assemble the whole issue as shown, and the injector will then do the doings in the manner usually observed among reliable boiler feeders.

The delivery clack is made in exactly the same way as the auxiliary clacks, but to the given sizes ; and instead of an ordinary male union screw at the bottom, it has a female one made from a bit of $\frac{5}{16}$-in. round rod $\frac{5}{16}$ in. long. Turn down $\frac{1}{16}$ in. of the end to a tight fit in a $\frac{3}{16}$-in. hole drilled at the bottom of the clack body ; then reverse in chuck, centre, drill right through with $\frac{1}{8}$-in. or No. 30 drill, open out and bottom to 7/32 in. depth with 7/32-in. drill and D-bit, and silver-solder into the clack body. Assemble as shown. If the clack doesn't stand vertically when screwed on the end of the injector, take a skim off the delivery cone flange, until it does.

The injector is located alongside the ashpan between the rear coupled wheel and the pony axlebox. If you haven't already done so, make up another auxiliary clack, without the by-pass connection ; couple it to the left side top feed. The bottom union of it is connected to the union on top of the injector clack by a 5/32-in. thin-walled pipe with union nuts and cones on each end. Make the bends easy. The steam end of the injector is connected to the injector steam valve on the backhead by a similar pipe, with a nut and cone at the valve end, and a nut and flat collar at the injector end. The water pipe is run through a pipe bracket under the drag beam, and we'll see about that, and the other connections for boiler feed, in the next instalment, if all's well.

The Sad Case of the Diesel-Burrell

NATURALLY, I have followed with great interest the many articles on traction engines which have appeared in THE MODEL ENGINEER during the past few years, because when I struck the happy idea of going out in my Austin Seven with my humble Kodak v.p. camera and photographing all the engines I could find, the Editor published some of them, and that seemed to reawaken the interest in steam.

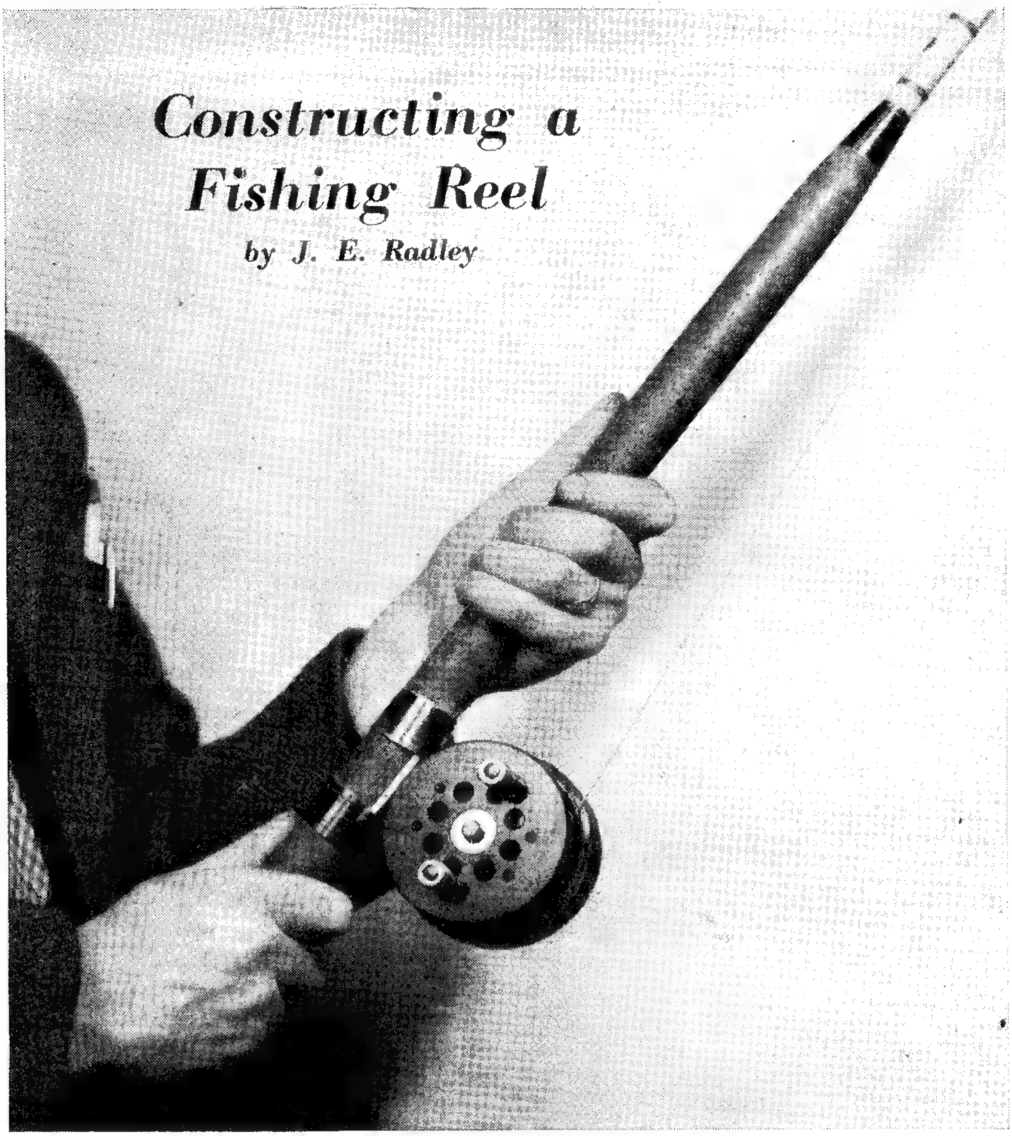
I suppose, therefore, that the reverse of poetic justice was bound to happen to me in a cruel world ! It happened the other day, when I was driving the self-same Austin Seven, but not, alas, equipped with my camera, along the pleasant road that cuts across open common-land between Hartley Wintney, in Hampshire, and Reading, in Berkshire.

Ahead of us was an obstruction, moving slowly but nevertheless an obstruction. As we came nearer, a pair of vast slatted wheels was observed—a traction engine towing some complicated mechanism that I think may have been something to do with dredging. But it was the engine that attracted my whole attention. Apart from the difficulty of overtaking it, no smoke swirled behind it in the winter breeze, no steam blew around its boiler.

Then, as we drew cautiously by, the mystery was solved, the horrid truth revealed. This vast Burrell had been converted to diesel power, a big engine being accommodated somewhere up in front. As my companion said, seeing my anxiety, why not use a modern diesel lorry and have done with it ?—W. BODDY.

Constructing a Fishing Reel

by J. E. Radley



THE reel described here has proved most popular among many angling friends. My $3\frac{1}{4}$-in. Grayson treadle lathe, now sixteen years old, has turned out 24 complete reels in the last six months. Special features are, variable check and drag easily operated, adjustable bearings with no fear of side play. A total weight of [illegible] oz.

The drawings are self-explanatory, but [illegible] few remarks about the main components may not be [illegible].

Wood Stock (A)

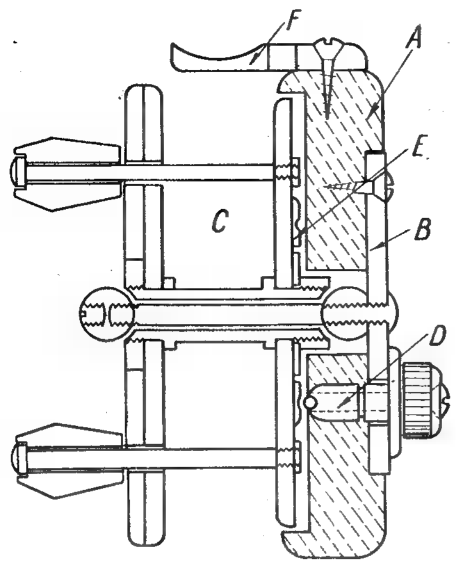
Close grained, well seasoned hard wood $3\frac{3}{8}$ in. diameter $\times$ $\frac{3}{4}$ in. recessed back and front [illegible] admit back plate *B* and [illegible] disc of line drum *C*. Cut away wood as shown at dotted lines to allow ball holder and flat spring to swing from check to free position. Finish stock with 2 coats boat varnish.

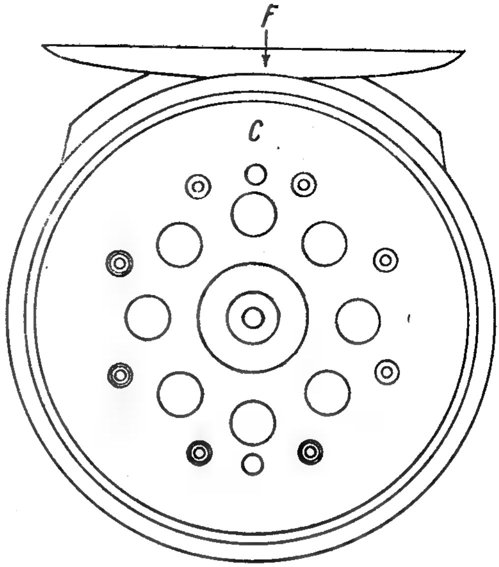
Back Plate (B)

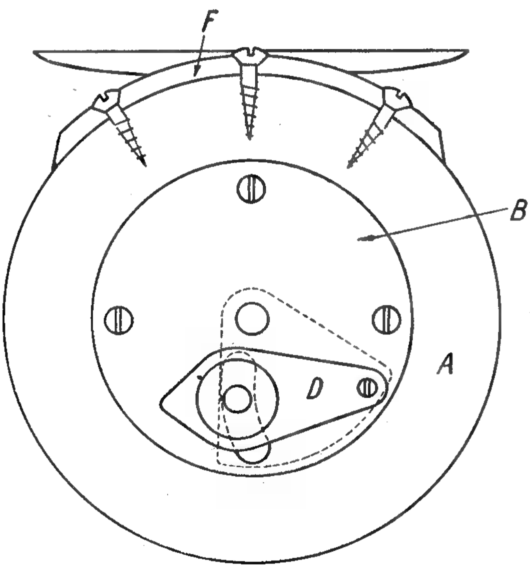
This is of 5/32-in. or $\frac{1}{8}$-in. aluminium, $2\frac{1}{4}$ in. diameter with $\frac{3}{16}$-in. silver-steel spindle screwed and rivetted after $\frac{3}{8}$-in. ball-bearing has been screwed on one end. Standard $\frac{3}{8}$-in. steel ball-bearings are used, softened over the gas burner. Bronze balls will do if steel main bush is used.

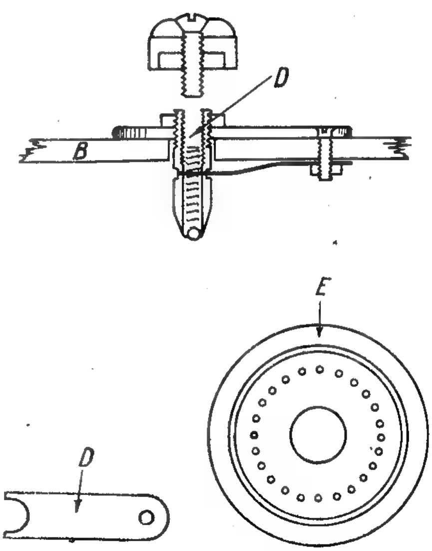
Line Drum (C)

Centre bush brass or steel $1\frac{5}{8}$ in. $\times$ $\frac{1}{2}$ in. diameter drilled through centre 7/32 in. turned









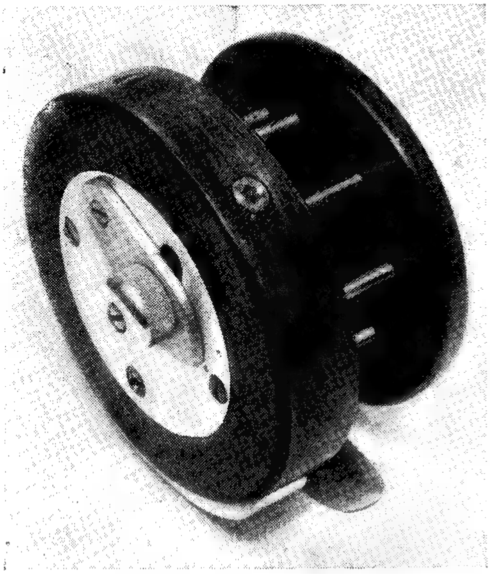
down each end $\frac{3}{8}$ in. × $\frac{3}{8}$ in. threaded $\frac{3}{8}$ in., trim off surplus ends and countersink to suit balls after assembly. Three plastic discs $\frac{1}{8}$ in. thick × $3\frac{1}{4}$ in. diameter are used for drum ends, drill [illegible] holes to take 8-B.A. screws equally spaced at 2 in. diameter. Distance tubes $\frac{1}{8}$ in. × $\frac{13}{16}$ in. brass, tapped each end 8 B.A., $\frac{1}{4}$ in. ventilation holes to be drilled in outer discs only.

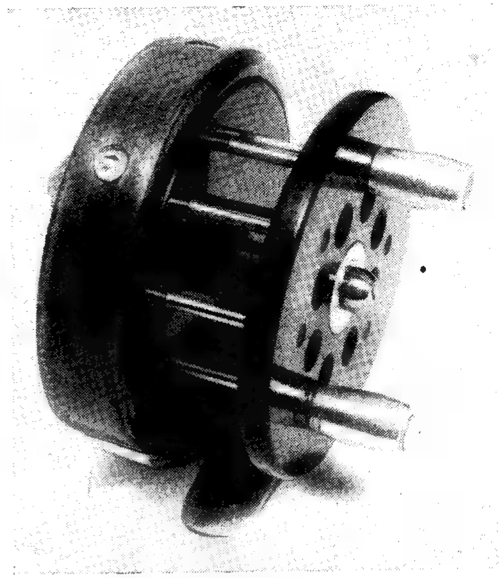
Ball Holder (D)

Round brass $\frac{3}{4}$ in. long × $\frac{1}{4}$ in. drilled through $\frac{1}{8}$ in., tapped 5/32 in. inside to a depth of $\frac{1}{2}$ in. one end turned over just sufficient to retain $\frac{1}{8}$-in. ball-bearing. The groove which admits flat spring *D* should be approx. $\frac{3}{8}$ in. from ball-end. Small coil spring as used for cigarette lighters will be found efficient for ball tension.

Check Plate (E)

Mild-steel disc $1\frac{1}{2}$ in. diameter × $\frac{1}{16}$ in. thick, bevel one outer edge to allow ball to ride up on to the plate, centre hole $\frac{3}{8}$ in. Drill approx. 25 No. 54 holes equally spaced at $\frac{13}{16}$ in. diameter,





set the drag groove at $1\frac{1}{8}$ in. dia. just deep enough to admit tip of ball-bearing. Case-hardened.

Rod Bracket (F)

Use 5/32 in. or $\frac{3}{16}$-in. aluminium, bend portion which is attached to the stock on a 3 in. mandrel, leave the saddle portion straight, this to be filed to suit rod handle, usually 1 in. radius.

It will be readily noticed by readers that any size of reel can be made using this principle of construction. I have just completed one at 5 in. for sea fishing, using brass components in place of aluminium and now await the opportunity of trying it out. I shall be only too pleased to help any "M.E." reader having difficulty in making this reel.

Armature Drop-testing

Armature drop-testing requires no special testing apparatus; all that is necessary is a suitable source of direct current, a sensitive low-reading voltmeter or milliammeter, a variable resistance and a pair of prods. Procedure: solder a lead to two comm. bars that are opposite each other; to these leads connect the source of supply including the variable resistance in one lead. Connect the prods by flexible leads to the meter being used. To test, put one prod on the bar having a lead soldered to it, the other lead to the next adjacent bar: adjust the variable resistance until a satisfactory reading is obtained on the meter. Now proceed round the comm. in the following order:—

If we call the lead bar No. 1, the next bar will be 2 and so on. The first coil is tested with the prods on bar 1 and 2, then on 2 and 3 and so on right round. It is necessary to keep the polarity the same for each bar, otherwise a reverse reading will be noticed. At the bar past the half you will get a reverse reading and it is only necessary to change over the prods to restore conditions. If the armature is free from faults you will get the same reading for all bars tested. With a hand-wound armature the coils will have different resistance values on account of the last coil wound on will have a greater length of wire than the first coil put on; this will give you a slightly different reading for progressive bars but not sufficient to upset the test. If the readings are wide and very variable, faults are indicated. No reading will indicate a shorted coil; a very high reading will show that a high resistance exists in the circuit and may be due to a faulty comm. bar connection or some other cause. If you get a full supply voltage reading it indicates that the coil being tested is open-circuited. If, during testing, you get a reverse reading, it indicates a reversed coil. An accumulator is more suitable to use for drop-testing because at times heavy currents may be necessary and dry cells cannot cater for these conditions while maintaining a steady voltage. Also, and before testing, the comm. should be turned all over to clear any carbon dust that, by its presence, gives false readings. Any form of wound coil may be tested in this manner for comparison with another.—F. W. COOPER.

*An Experimental Steam Turbine Plant

A chronicle of many endeavours and trials in the quest for r.p.m.

by D. H. Chaddock

THE basis of the design was two little brass gears, 7/32 in. outside diameter, 3/32 in. wide, with 20 teeth, again about 108 d.p. A rough calculation showed that used as a gear pump they should deliver 1 oz. per minute per 1,000 r.p.m. Therefore, to supply the 4 oz. per minute estimated to be needed for the nozzles the pump would have to run at about 4,000 r.p.m.; very reasonable in view of its small size and not needing an inconveniently large reduction ratio from the main shaft.

*Continued from page 22, "M.E.," January 4, 1951.

The pump, as finally made, is shown in the drawings and photograph already referred to in Figs. 6 and 7. It follows a design with which I became familiar during the war. The casing is bored completely through with two parallel holes, pitch centre distance apart and of diameter equal to the tips of the gear teeth. The bearings are in the form of circular bushes, with a flat on one side which fit these holes and accurately locate the gear shafts in the centres of the holes. The end covers are plain plates and serve merely to hold the parts in place. To save side thrust on the shafts the main driving gear is carried on a quill and drives the pump through a square

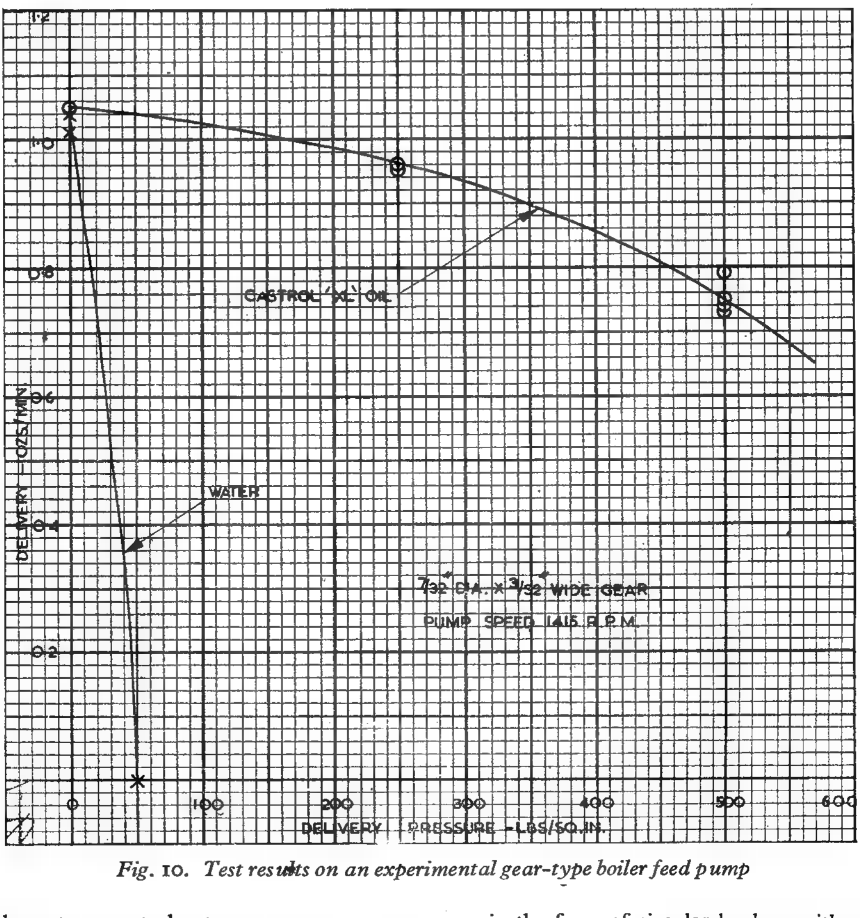


Fig. 10. Test results on an experimental gear-type boiler feed pump

on the end of the shaft, a device copied from Mr. Westbury's "1831" oil pump drive.

Pressure and Delivery Tests

I built the pump as carefully as I could and tested it first driven from the lathe and pumping ordinary "Castrol XL" engine oil, partly to run it in under favourable circumstances and partly because I could not believe that such a tiny object would pump at all. I was pleasantly surprised; not only did it pump but even at 500 lb. per sq. in. the delivery was 75 per cent. of the no-load performance. When I changed to water, however, the story was quite different. It pumped quite well with a free discharge but the slightest back pressure reduced the delivery to a mere trickle.

I rebuilt that pump three times, reducing the clearances and improving the finish at each attempt until, finally, the parts would wring together and I verily believe the clearances were nowhere more than a tenth of a thou. Still it would not pump water at the pressure that I wanted. The graph, Fig. 10, shows the results finally obtained for both oil and water, and in view of all the work put in it was bitterly disappointing.

"L.B.S.C." to the Rescue

If I could not have a pump with no pistons or valves I could at least have one with no valves. "L.B.S.C.'s" famous little mechanical lubricators are known to pump heavy cylinder oil at 400 lb. per sq. in. Would they pump water at 500 lb. per sq. in. and running at several thousands of r.p.m.? The practical evidence has already been referred to in Fig. 8 which shows an exact copy of one of the lubricator pumps, $\frac{1}{8}$ in. bore by $\frac{1}{4}$ in. stroke, in use as a feed pump.

More interesting is the graph shown in Fig. 11 which shows the measured delivery of the pump at two pressures and various speeds. Not only is the volumetric efficiency very high at these pressures, between 80 and 90 per cent., but the pump seemed quite happy even at 1,200 r.p.m.

But there were two wasps in the jam pot. One was the very heavy spring pressure, several pounds, that was needed to keep the port faces in contact under these conditions. Although the faces were liberally smeared with non-separating grease before assembly this rapidly squeezed out under the combined effects of speed and pressure, and had to be renewed each run to

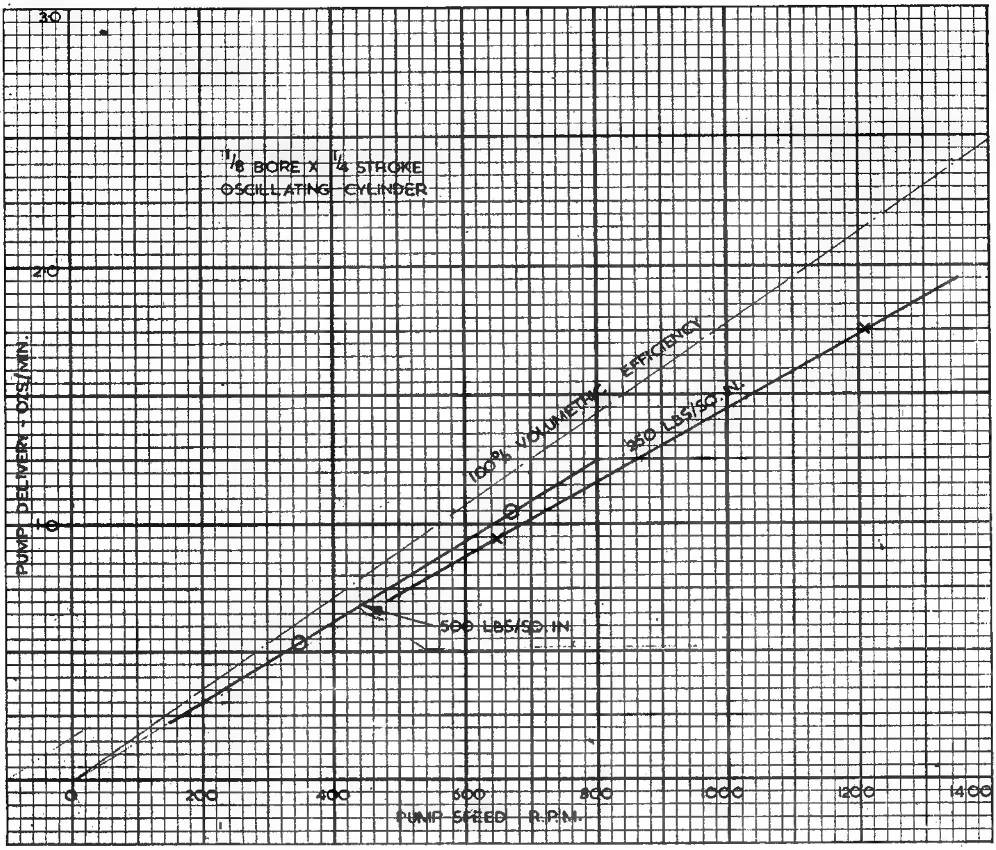


Fig. 11. Test results on an oscillating cylinder lubricator pump, used as a boiler feed pump

avoid scoring the port faces. To ameliorate this a false port face of stainless steel was sweated on to the cylinder block and lapped true. Even so, the minutest score, particularly between the inlet and outlet ports, caused the pressure to drop in the most alarming manner and I felt that in a boat and with average pond water the pump would not live.

500 lb. per sq. in. back pressure the delivery did not increase but fell off into intermittent spurts and bubbles. Suspecting cavitation the port sizes were enlarged but that made things worse and not better, the stipulated sizes in "words and music" giving the best results. How that man does find the right answers!

However, to get the delivery I wanted, 4 oz.

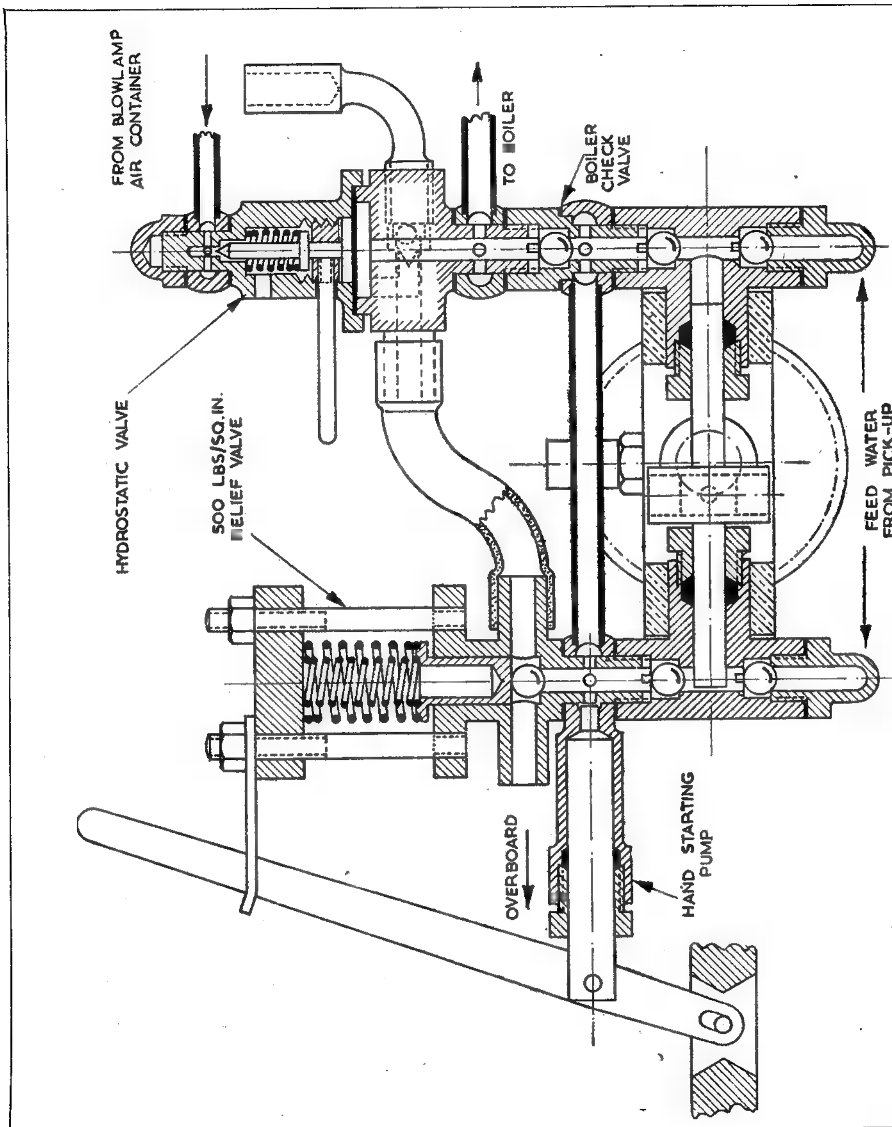


Fig. 12. *Jug and Bottle Department!* *Twin feed pumps, control and starting devices. The starting pump is shown turned 90 deg. from its true position*

per minute, it was obvious that the pump would have to run at 2,500 r.p.m. and, combined with the other difficulties mentioned, decided me that I really was asking too much of a piece of apparatus which had never been designed for this purpose.

Another fault was found in the plant surging, when using this pump, first running up to speed and then slowing down again in rhythmical cycles. This was finally traced to the pump and by putting it back on test at higher speeds it was found that above about 1,200 r.p.m. and with

A Twin-cylinder Plunger Pump

There seemed to be nothing for it but to follow the beaten path and have a conventional plunger pump complete with valves and all. It seemed also as if a larger plunger was needed than the $\frac{1}{8}$ in. diameter that I had been using if the speed and pressure would be quite readily reached at about 1,500 r.p.m.

Bench Tests of the Turbine Under Power

I was now in a position to get down to some really serious bench testing of the turbine. I

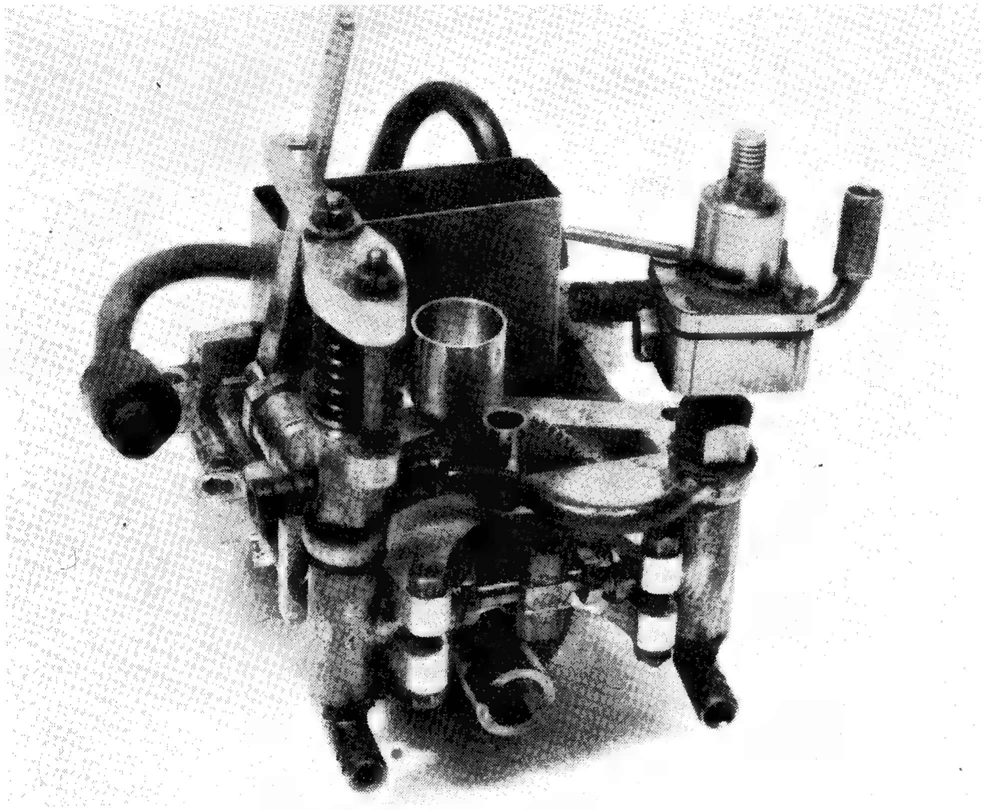


Fig. 13. The turbine in its final form, complete with feed pumps and control devices. Weight, 9 ozs.

was to be kept down to a reasonable figure. $\frac{3}{16}$ in. diameter, giving roughly twice the capacity, seemed to be called for, but I was rather anxious about the effect the sudden load, which would be applied when the big plunger met the full boiler pressure, would have on the rather fragile turbine gearing.

May as well be hanged for a sheep as a lamb, so I decided on twin pumps the same size as before but working horizontally opposed and driven by a single Scotch crank between them. The outcome is shown in Fig. 12 and the photograph, Fig. 13. Bearing in mind Mr. Turpin's troubles with a duplex feed pump in *Tich Too*, I took care to keep each pump independent in all its functions to avoid mysterious interaction.

On bench test these pumps functioned quite well and the "acceptance curve," shown in Fig. 14, indicates that the specified delivery first rigged up a drive for the twin-cylinder feed pump from a small electric motor with a speed indicator and a rheostat to control it. In this way, having previously plotted the speed delivery curve, I could tell in advance how much water the pump was delivering and be free to conduct experiments at the turbine end.

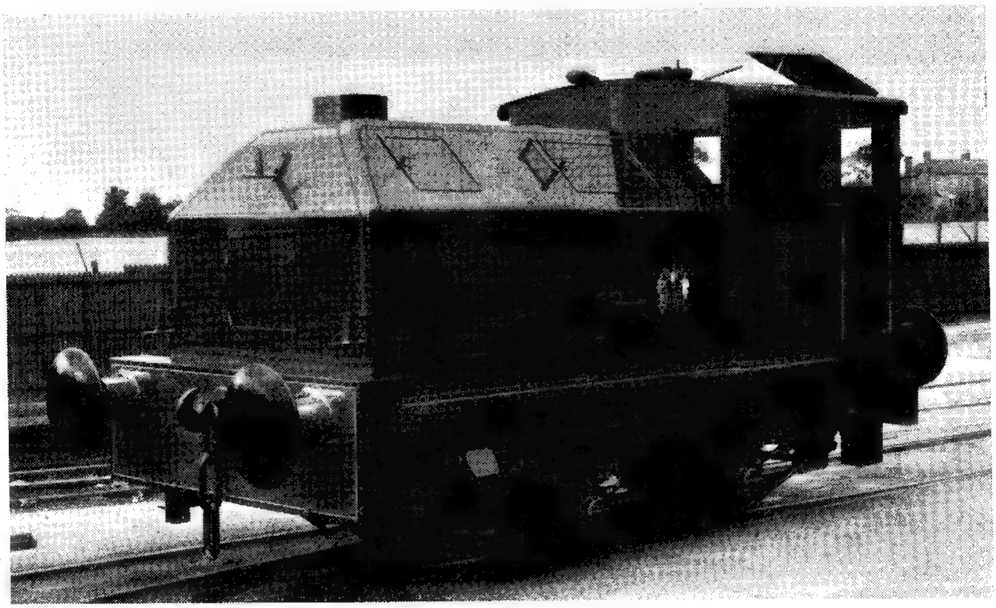
The first few runs were made without the turbine wheel in place and served to check the operation of the whole plant and the steam consumption of nozzles which were, of course, discharging freely into the atmosphere. I speedily found that if the steam was really hot, so hot that it was superheated and invisible after expansion, the required working pressure could be maintained. If, however, a start was made with wet steam the nozzles gobbled up an enormous amount of water and the boiler usually ended up by flooding.

(*To be continued*)

An Unusual Steam Locomotive

by J. N. Walton

THE geared locomotive, built by Sentinel (Shrewsbury) Ltd., is designed expressly for use in the sidings of industrial concerns. The incorporation of three change-speed gears, to suit various loads and gradients, enables shunting work to be done in the most efficient manner and at a very low cost. In comparison with level—a locomotive of orthodox design to be able to start such a load would have to have cylinders and boiler to match of much larger capacity, which would incidentally enable it to haul at a much higher speed (once under way) than is necessary or of advantage in industrial shunting operations. In extended trials the

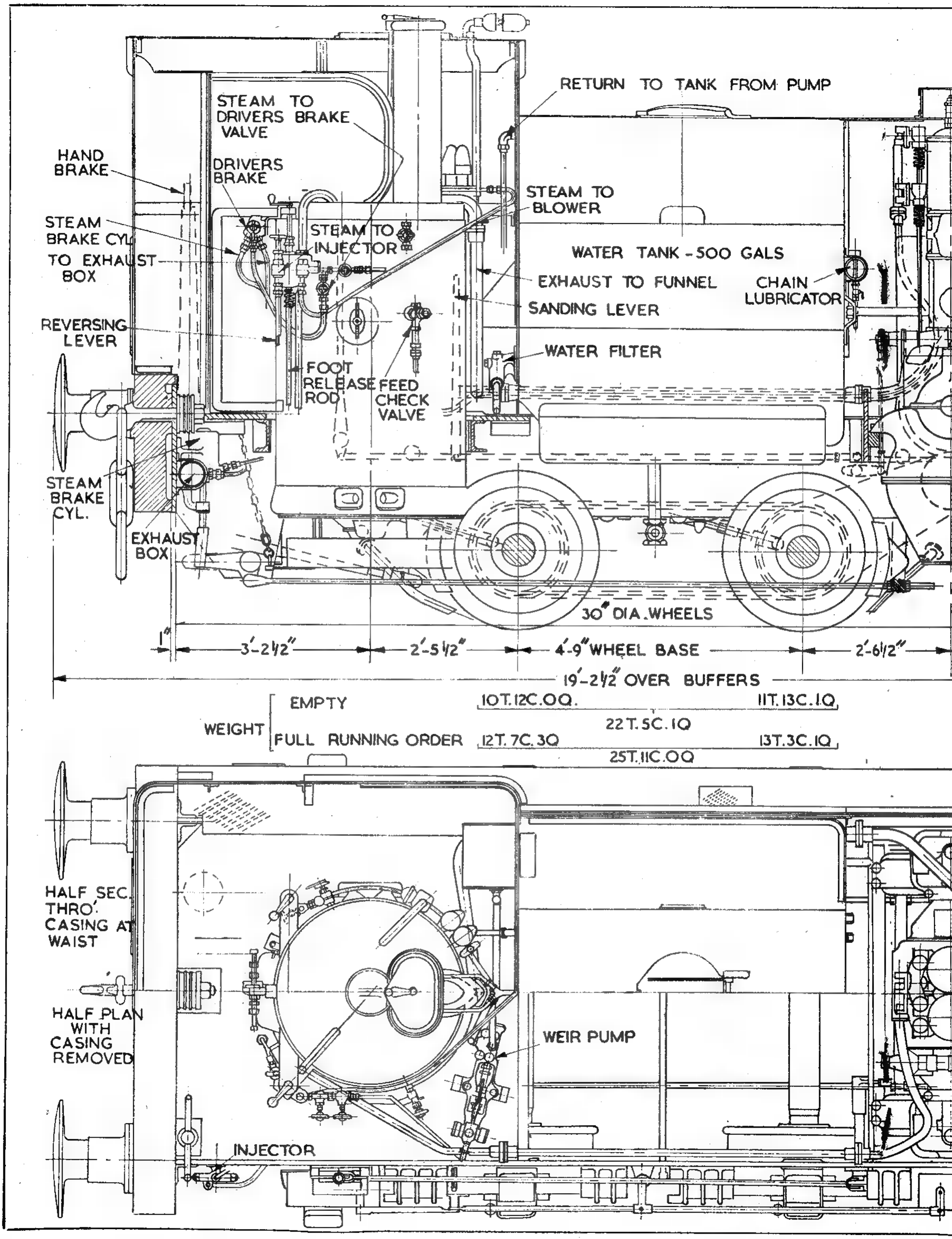


its diesel counterparts it has proved to be more economical and more suitable for the job, owing to the unrivalled "flexibility" of the reciprocating steam engine—which only goes to prove that "steam" has by no means reached its maximum development.

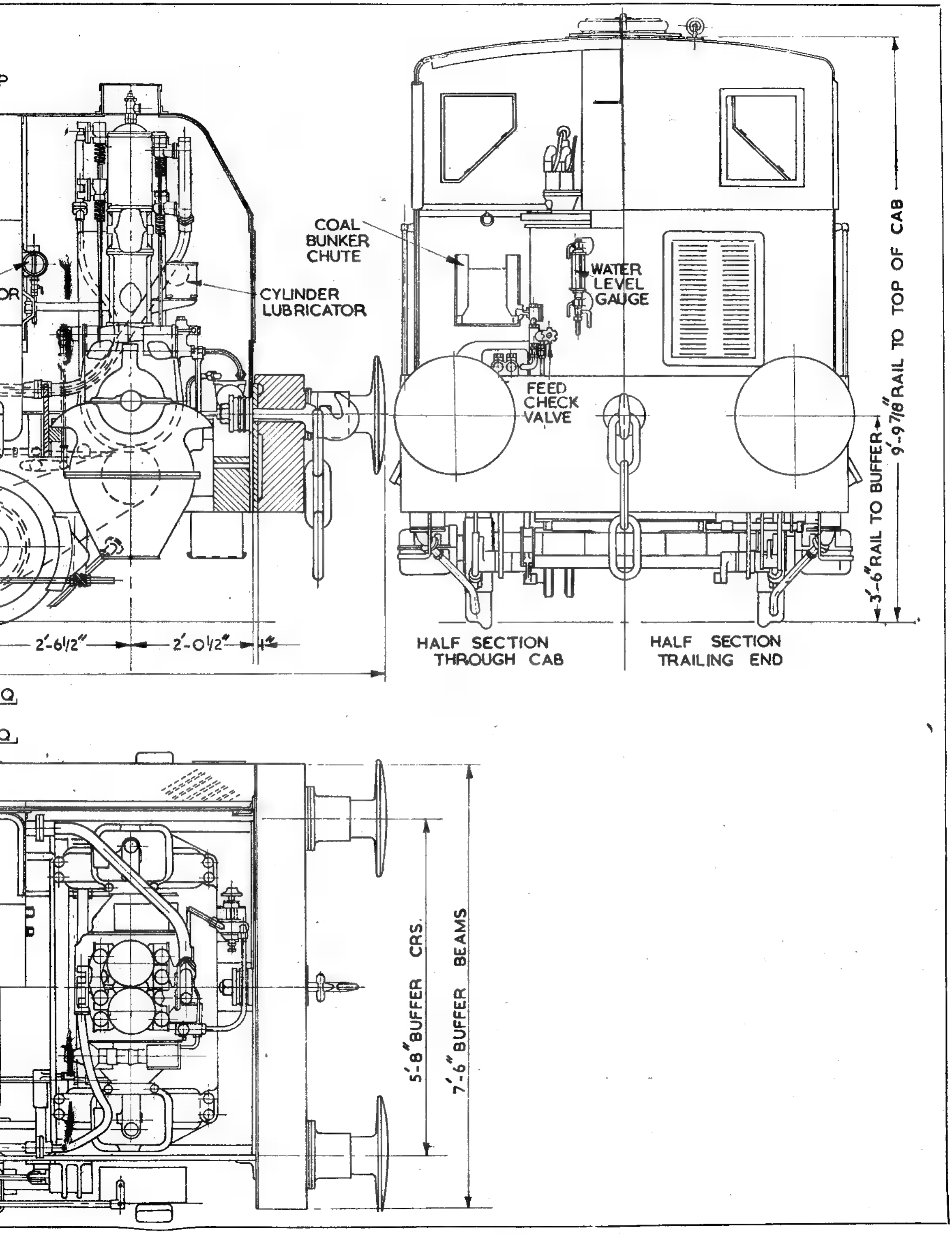
The standard design, developing 100 b.h.p., is made available for all gauges from 3 ft. to 5 ft. 6 in. and can be obtained in three gearbox-to-axle ratios, each type having change-speed gears, to suit particular conditions. The Sentinel vertical water-tube boiler, working pressure 275 lb./sq. in., placed just behind the rear axle, supplies all the steam the two-cylinder double-acting simple expansion engine can use. The latter has a normal maximum r.p.m. of 500, the steam admission and exhaust being controlled by cam-shaft-operated poppet valves, with two positions of cut-off, in each direction, of 75 and 40 per cent. Here is the clue to the economy of the Sentinel locomotive, the engine by reason of the geared drive to the wheels is capable of exerting sufficient effort to haul a load of 682 tons, on the Sentinel locomotive has been shown almost invariably to give a fuel consumption of at least half of an equivalent orthodox steam locomotive; also, one man is comfortably able to drive and fire the geared engine.

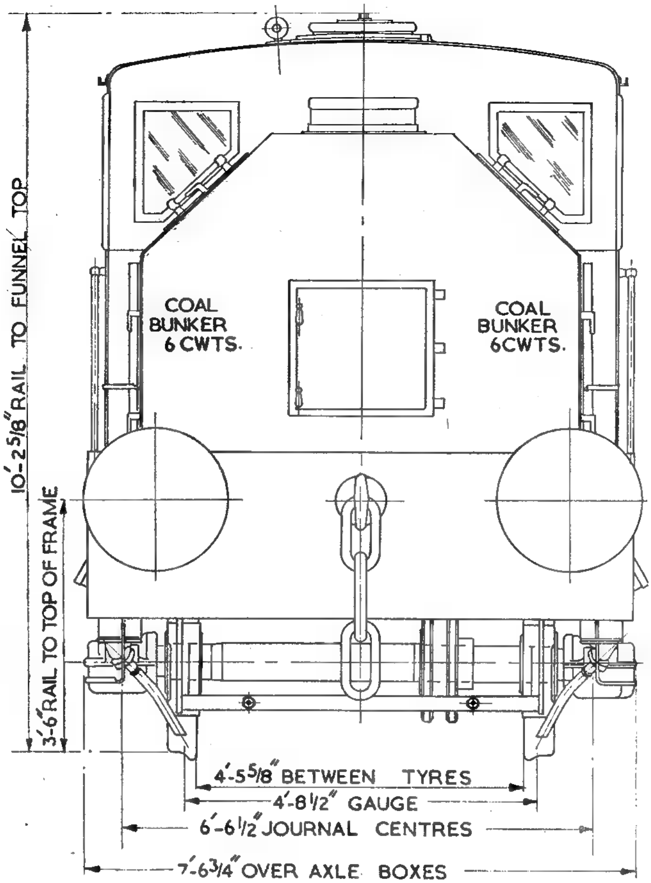
Reference to the illustrations will show that the external outline is of clean and pleasing appearance—great scope here for an unusual and simple model, which can be legitimately painted in a livery to suit the tastes of the model-maker. The writer confesses to having no experience in the craft of model-making, but considers that the "innards" could be suitably doctored a la "L.B.S.C." to give a comparative performance, which would emulate or even improve upon that of the prototype; also, ample space for the "works" could be found by selecting a prototype of 3 ft. gauge. The following dimensions will be of value to the model-maker.

Length over headstocks 16 ft. 7 in. (4 ft. 8½ in. gauge and upwards), 17 ft. 1 in. (3 ft. and 3 ft. 6 in. gauge).



RETURN TO TANK FROM PUMP
STEAM TO DRIVERS BRAKE VALVE
HAND BRAKE
DRIVERS BRAKE
STEAM BRAKE CYL
TO EXHAUST BOX
STEAM TO INJECTOR
STEAM TO BLOWER
WATER TANK - 500 GALS
EXHAUST TO FUNNEL
CHAIN LUBRICATOR
SANDING LEVER
REVERSING LEVER
WATER FILTER
FOOT RELEASE ROD
FEED CHECK VALVE
STEAM BRAKE CYL.
EXHAUST BOX
30" DIA. WHEELS
1"
3'-2½"
2'-5½"
4'-9" WHEEL BASE
2'-6½"
19'-2½" OVER BUFFERS
WEIGHT
EMPTY
FULL RUNNING ORDER
10T. 12C. 0Q.
11T. 13C. 1Q.
22T. 5C. 1Q
12T. 7C. 3Q
13T. 3C. 1Q.
25T. 11C. 0Q
HALF SEC. THRO' CASING AT WAIST
HALF PLAN WITH CASING REMOVED
WEIR PUMP
INJECTOR


COAL BUNKER CHUTE
CYLINDER LUBRICATOR
WATER LEVEL GAUGE
FEED CHECK VALVE
HALF SECTION THROUGH CAB
HALF SECTION TRAILING END
9'-9 7/8" RAIL TO TOP OF CAB
3'-6" RAIL TO BUFFER
2'-6½"
2'-0½"
5'-8" BUFFER CRS.
7'-6" BUFFER BEAMS



Width overall—7 ft. 6 in. to 8 ft. 6 in. (varies with gauge).

Height overall (without spark arrester)—10 ft. 2⅝ in.

Gauges—3 ft. to 5 ft. 6 in.

Wheelbase (nominal)—4 ft. 9 in.

Journal size—9 in. by 4¼ in.

Wheel diameter on tread—30 in.

Engine

" Sentinel " vertical enclosed high-speed 2-cylinder, double-acting, with reduction gear.

Bore and stroke—6¾ in. by 9 in.

Valve—" poppet."

Boiler

" Sentinel " vertical water-tube type.

Working pressure—275 lb./sq. in.

Heating surfaces (sq. ft.):

Tubes 33.25; Firebox 31.03; Superheater 17.9; Grate [illegible] (sq. ft.) 5.1

Water tank capacity—500 gals.

Bunker capacity—12 cwt.

Boiler feed—" Weir " steam-driven pump and live steam injector.

Brake gear—Steam and hand 4 block.

Sanding gear—Hand, 4 point.

Weight in working order—24 tons approx.

The prototype can be fitted with automatic thermo-feed, rocking fire-grates and other special fittings, which make it a remarkably easy locomotive to drive and fire—and one, moreover, which is of much smaller first cost than the equivalent diesel locomotive. The writer is informed that a heavier model of 28-33 tons weight, developing 210 b.h.p. will soon be available, this model is capable of hauling, on level track, [illegible] load of 1,360 tons!

For permission to publish the above information and to reproduce the drawings, I am indebted to the sole concessionaires for the British Isles of the Sentinel Locomotive, Thomas Hill (Commercial Vehicles) Ltd., Vanguard Works, Whiston, Rotherham, Yorkshire.

IN THE WORKSHOP

by "Duplex"

No. 80—Paint Guns

THE spray gun is, undoubtedly, one of the most useful pieces of equipment, for with it pigments of all kinds can be sprayed quickly, evenly and, with due care, economically. The cost of commercial-made guns tends to prohibit their use by most amateurs ; it is, therefore, proposed to describe ■ simple form of paint gun which has been tested over ■ number of years and has always given very satisfactory results.

It is easily made in the small workshop and will handle almost anything, for it has been used to spray Snowcem on to the outside of buildings, for covering woodwork with creosote, as well as carrying out household interior decoration with washable paints and distemper.

In addition, the gun has been used to re-touch the cellulose paintwork of cars, to spray penetrating oil on their chassis and to paint outside ironwork with bituminous pigments.

It will be seen, from the foregoing remarks, that the gun is very versatile and can be used with almost any paints which will be needed by the amateur.

Types of Spray Paint Gun

The guns used by commercial undertakings operate on compressed air at ■ relatively high pressure as compared with those forms of gun which are designed to be run from the domestic vacuum cleaner ; these latter do not concern us here.

There are two forms of the high-pressure gun and both are illustrated in Fig. 1 and Fig. 1A. Fig. 1 is ■ type in which the paint is fed to the spray nozzle by gravity whereas the gun, Fig. 1A, draws the pigment from the container by suction, the principle upon which it operates being that of the injector used for pumping fluids.

Both types of gun work satisfactorily, but practical experience has shown that the injector gun is the more convenient to use, as it is better

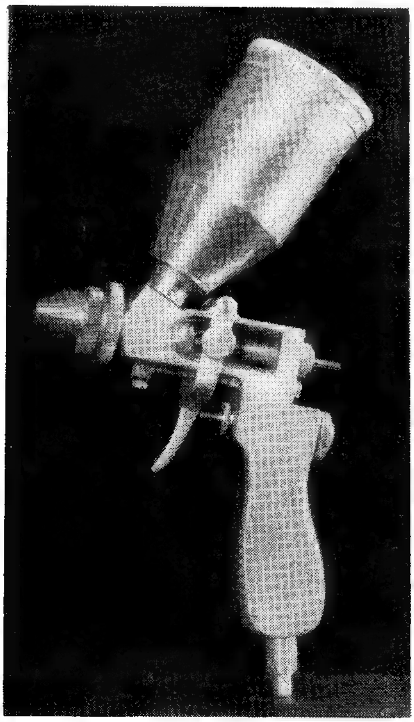


Fig. 1. A gravity feed paint gun

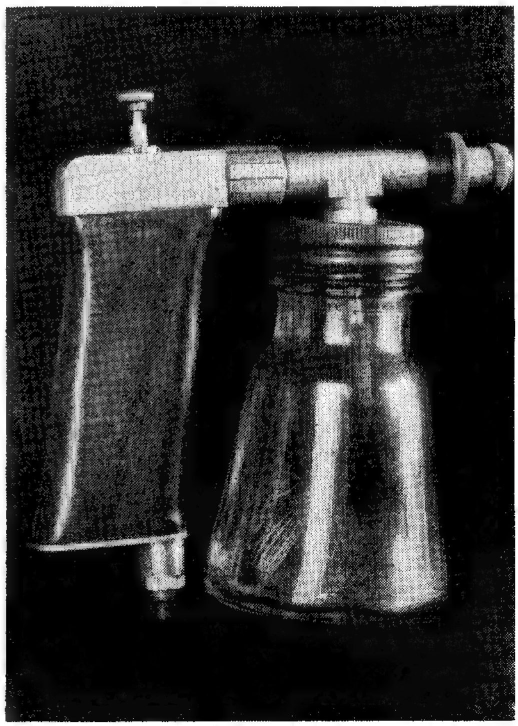


Fig. 1A. The "Model Engineer" suction feed paint gun

balanced. Moreover, both hands can be used to hold and direct it, a fact which professional painters seem to appreciate.

The injector gun is illustrated diagrammatically in Fig. 2, and it will be seen that the tubular body which is T-shaped, has an air tube passing through it axially. The air tube terminates in a jet or nozzle which is centred in the combining cone fitted to the outer extremity of the body. If a supply of compressed air is passed through the air tube, and the relationship of the air jet and combining cone is correctly adjusted, a partial vacuum will be produced in the body and paint will be drawn up the paint tube, and will pass to the combining cone where it will mix with the air issuing from the air jet and be sprayed on the work in a finely atomised state.

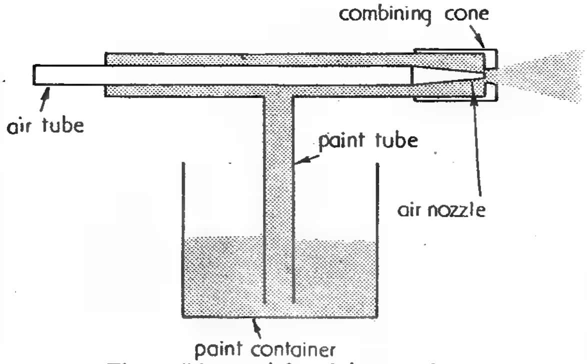


Fig. 2. Diagram of an injector paint gun

The gun, in its practical form, is illustrated in Fig. 3. This arrangement is substantially the same as the original design introduced by Mr. E. T. Westbury and described in THE MODEL ENGINEER on November 2nd, 1933. Some minor modifications have been made to suit the particular methods of construction that were used, but apart from this the gun follows the designers arrangement.

It will be observed that the practical gun closely resembles the diagrammatic illustration, Fig. 2 and that a handle incorporating the control valve has been added, as well as a simple method of supporting the air tube so that it remains accurately centred in the body. This is important, for the success of the gun depends upon the air nozzle being concentric with the

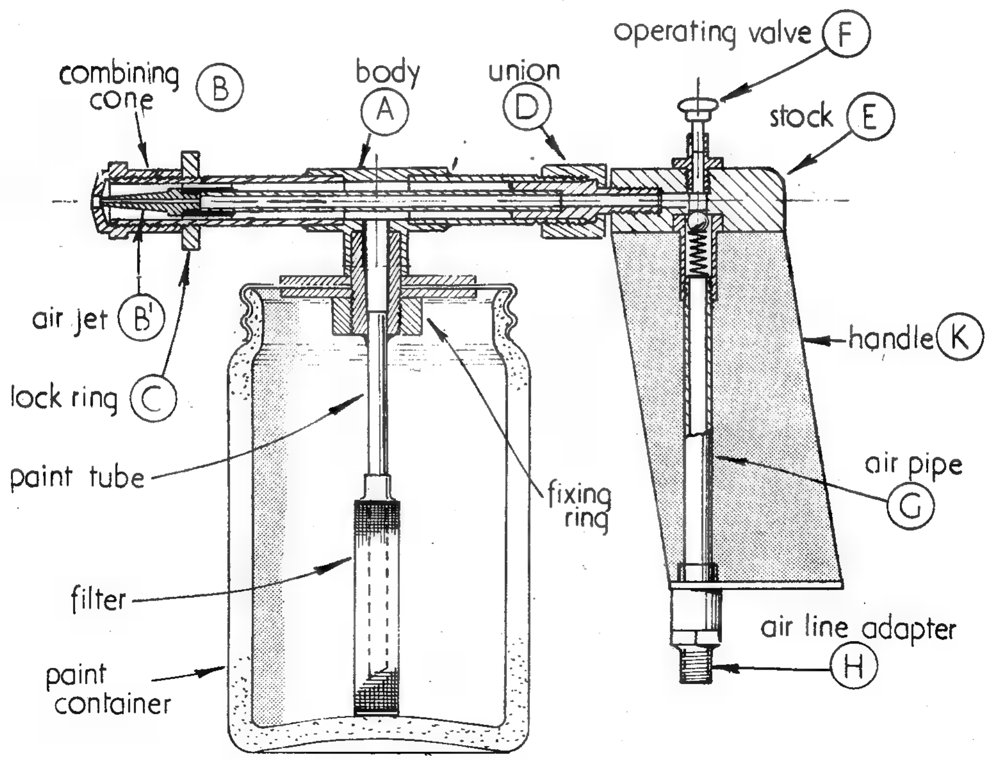


Fig. 3

combining cone, which is threaded on the body.

The air nozzle may, then, be allowed to enter the outlet of the cone to a greater or lesser extent varying, at will, the volume of the paint which is delivered ; for, by screwing the cone down on to the air nozzle, the paint outlet, which is in fact an anular orifice formed between the nozzle and the cone, can be completely closed, whilst unscrewing the combining cone will gradually enlarge the paint outlet. The relative position of the two parts is shown in Fig. 4, at *A* when the orifice is closed and at *B* when the paint outlet is open.

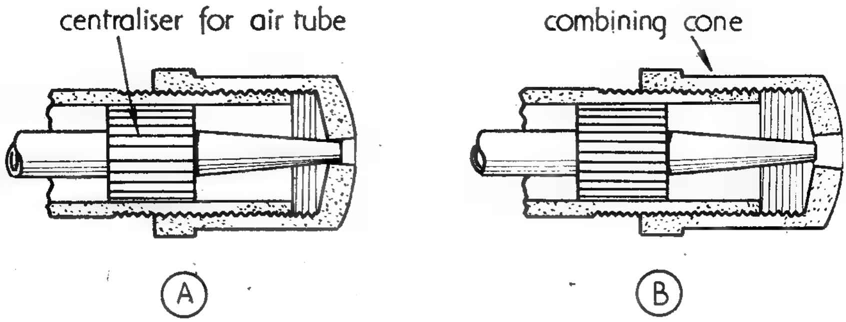


Fig. 4. Position of combining cone and air nozzle. " A "—with paint orifice closed ; " B "—with paint orifice open

Centralising

It will be seen that the method used for centralising the air tube is also shown in the illustration. The arrangement consists of ■ brass plug which is a sliding fit in the body, is threaded at one end to accommodate the air nozzle and has the air tube sweated into the opposite end. The plug has a series of slots formed on it to enable paint to flow to the combining cone. In the gun illustrated in Fig. 5A and B it will be observed that the centralising device is, in fact, a short length of brass gear pinion which was cut for other purposes. The short length which was left over suited this purpose admirably.

The device is quite satisfactory for paints of all types, but tends to become blocked if Snowcem is being used. Under these circumstances ■ temporary clearance can be effected by pressing ■ finger over the outlet from the combining cone and momentarily depressing the control valve. This action will blow any foreign matter, or coarse elements in the pigment, back, into the container. It should be noted, however, that the container is made of glass, so that much treatment of this nature may eventually lead to ■ burst, even though the container is open to atmosphere by way of a small hole drilled in the metal cap. If much use is to be made of Snowcem or distempers. it is better to make the centralising device in the form illustrated in Fig. 6. This arrangement will not clog easily moreover, it obviates gear cutting, an operation for which no equipment may be available.

No elaborate apparatus is needed to make this part, for, after turning the blank from a short length of brass bar, the component is easily filed to shape.

Built-up Construction

The main details of the gun will be evident from the illustration, and it will be observed that, to facilitate construction, the body is built up, the parts necessary to do this being machined from rectangular and round brass bar. The hardwood handle is secured to the stock by means of the air feed-pipe which serves as a stud for this puprose. The control valve is incorporated in the upper end of this pipe, whilst the plunger to operate it is carried in ■ screwed bushing which fits into the top of the stock, and is then within comfortable reach of the operator's

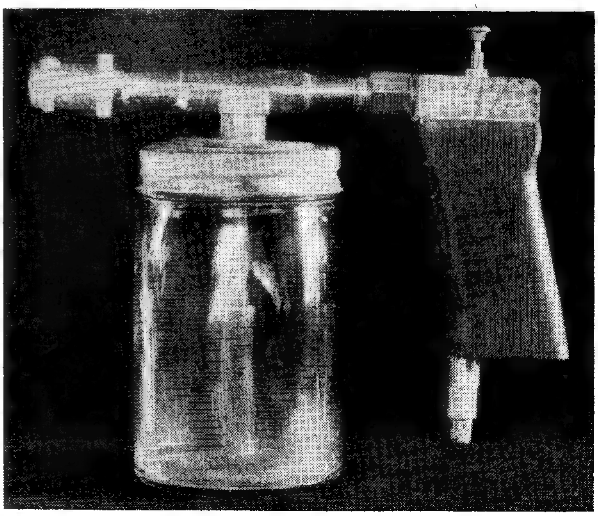


Fig. 5A. The modified " Model Engineer " paint gun

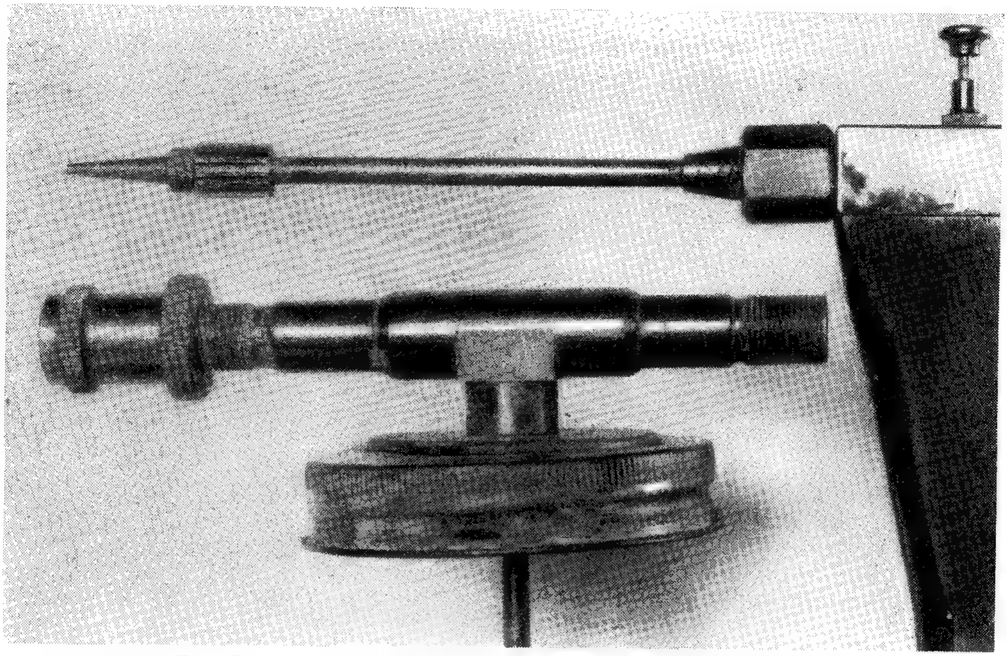


Fig. 5B. The gun with air tube withdrawn to show centralising device

right thumb, (or left thumb of the lefthanded operator.)

A flat-faced union is fitted to the stock and projects horizontally to engage with the body of the gun. The union itself is made from steel bar so that it may withstand shock and avoid breakage at the entry to the stock.

The horizontal air-pipe is cut to length from brass tubing which, as normally supplied, is

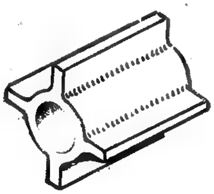


Fig. 6. Modified centralising device

sufficiently straight for the purpose. It is afterwards sweated into the union. It should be noted that the fit of the tube in the union and centring device must be close, or the alignment of this assembly will be at fault, and there may then be difficulty in passing the air tube into the body. It may be opportune, therefore, to point out that both the centring device and the body of the union should be a firm sliding fit over the tube; then, when they are sweated together, they will remain in alignment.

The paint container is most conveniently contrived from a screw-top glass jar, though a suitable metal recepticle is to be preferred if available; the risk of breakage is then removed.

As the metal tops of glass jars are usually somewhat weak, it will be necessary to re-inforce the cap with a pair of large washers, as seen in the illustration.

A filter or strainer is fitted to the paint tube so as to prevent any lumps or foreign matter being drawn into the gun. The filter is a firm sliding fit on the tube, but is not attached to it positively, since, when using distemper or Snowcem, the strainer must be removed, otherwise these particular pigments cannot be sprayed.

(*To be continued*)

Dowel as Holder for Small Parts

I have discovered that a very excellent holder for small and tiny objects that require to be polished or ground can be made from a short split dowel.

First insert the dowel in the jaws of a tap-wrench. Then place the job in the slit of the dowel and tighten the chuck. Also, small screws can be held in a split dowel when cutting off the heads and re-slotting.—A. RICHARDS.

The "M.E." Visits the Grimsby S. of M. & E. E.'S Exhibition

Reported by G. W. Arthur-Brand

WE are always pleased to visit clubs up and down the country and to meet and exchange views with their many interesting members. Such an opportunity was afforded us recently when we paid a visit to the highly successful exhibition of the Grimsby society, which was held at the Augusta Street Barracks, Grimsby.

Nearly three hundred items were on view and the general standard was so high that the judges had ■ difficult time assessing the winners in the various classes. The ship section, as might be imagined, was exceedingly strong, and the writer was pleased not only with the quality of the work in most cases, but also with the variety of types depicted. The winner in this section was Mr. Gregory Scunthorpe, whose very fine model of ■ deep-sea trawler is illustrated below.

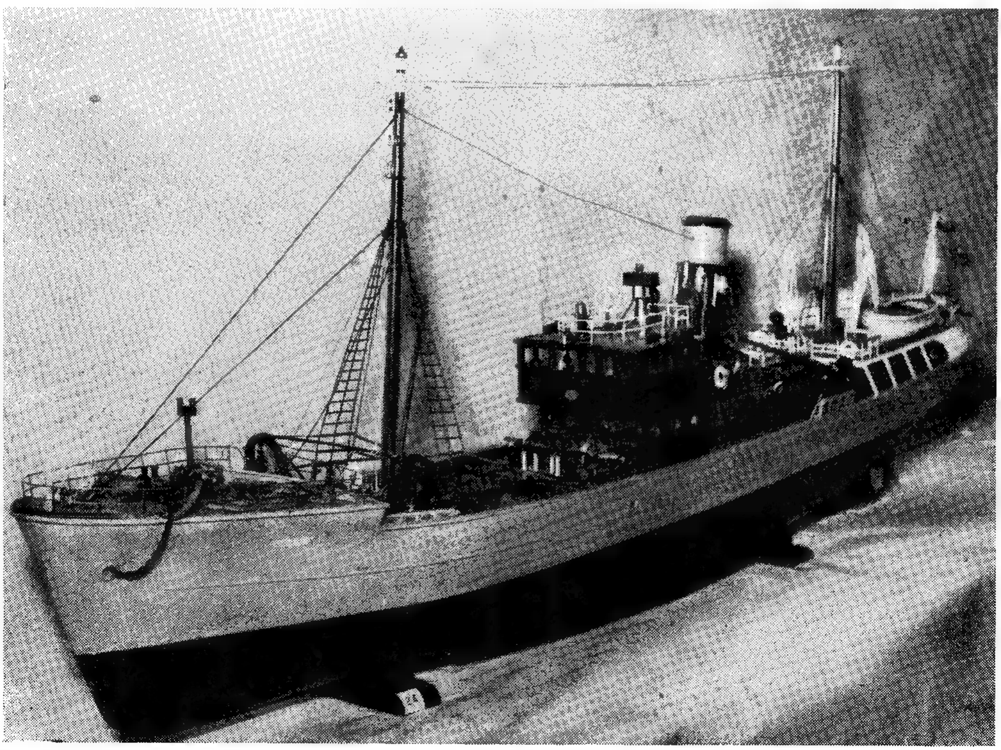
In the locomotive section, Mr. Barnet, of Lincoln, collected the first prize with his $3\frac{1}{2}$-in. gauge L.M.S. locomotive *British Legion*. This, too, was a fine piece of work and should be a capable performer.

The traction engines were led by ■ magnificent showman's road locomotive, the work of Mr. E. Lowe, of Rotherham. Unfortunately, the illustrations fall short of doing justice to the display of workmanship which graced the model, but those of our readers who have experience of this type will undoubtedly be able to pick out the various little tit-bits which are in evidence in each photograph. The writer was very pleased to award the Championship Cup to this model.

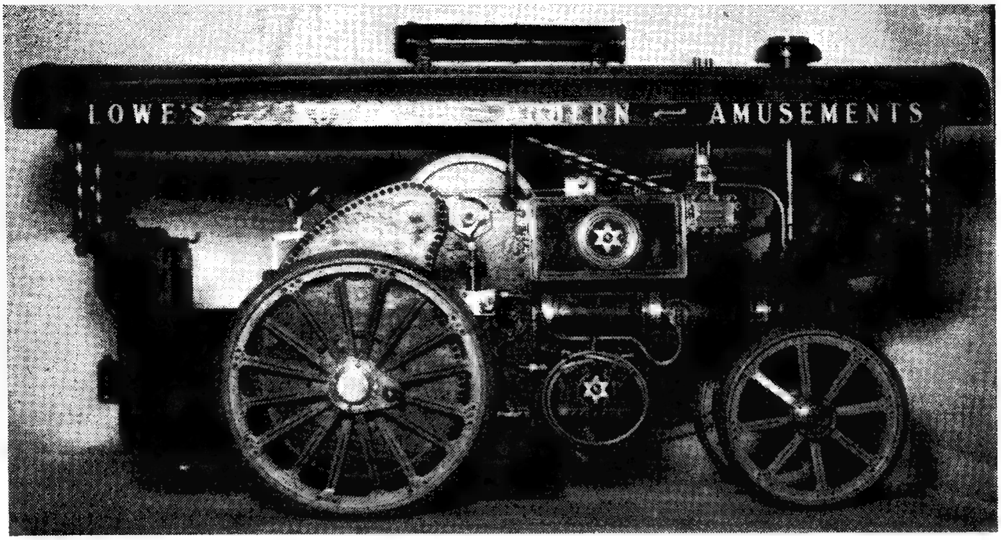
The model railway track was kept busy taking the kiddies for rides, and strong model car and model aircraft sections gave demonstrations in the evening under ■ separate roof.

Other items worthy of special mention were the many beautiful examples of hand carving and ■ number of excellent clocks.

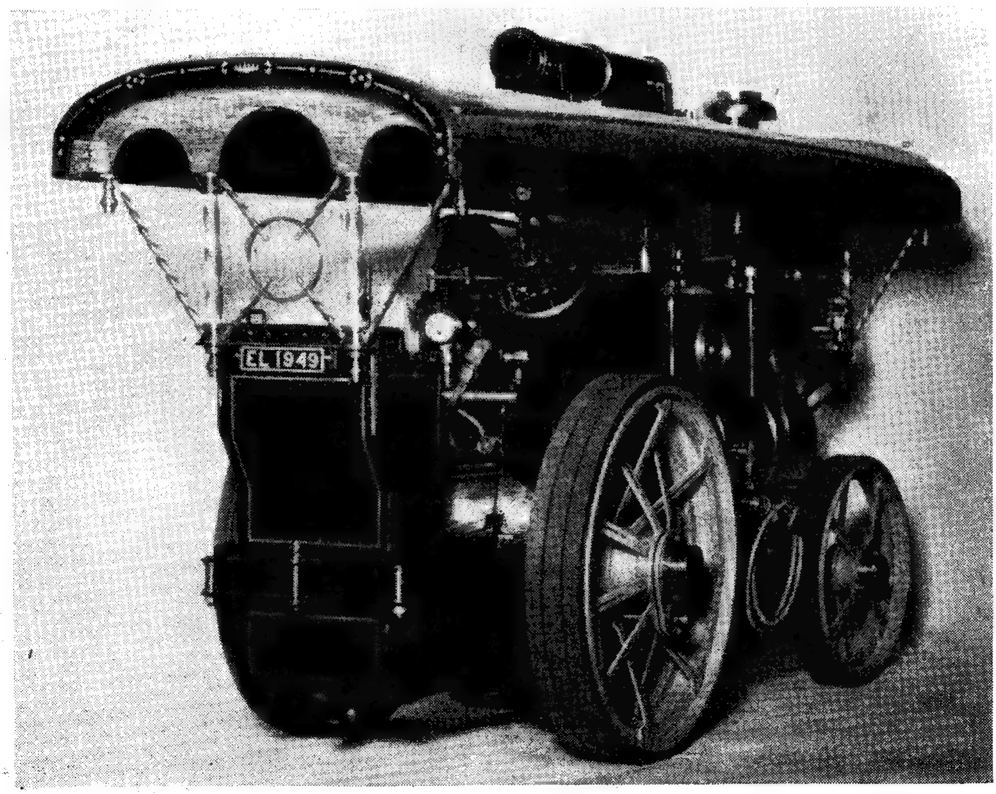
There can be no doubt at all that this society is very much alive and is doing great work to forward the cause of model engineering in the Grimsby area.



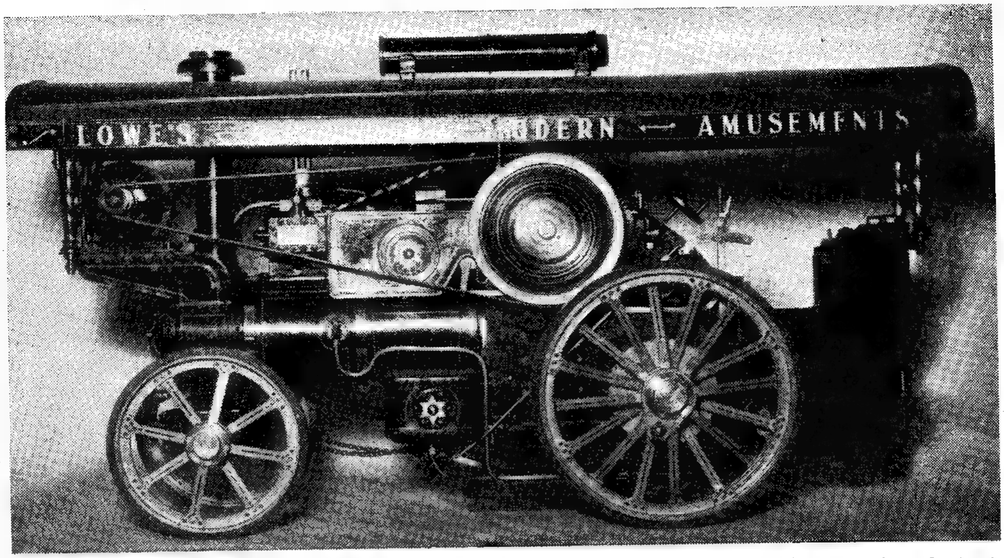
Mr. Gregory Scunthorpe's very fine model of a deep-sea trawler



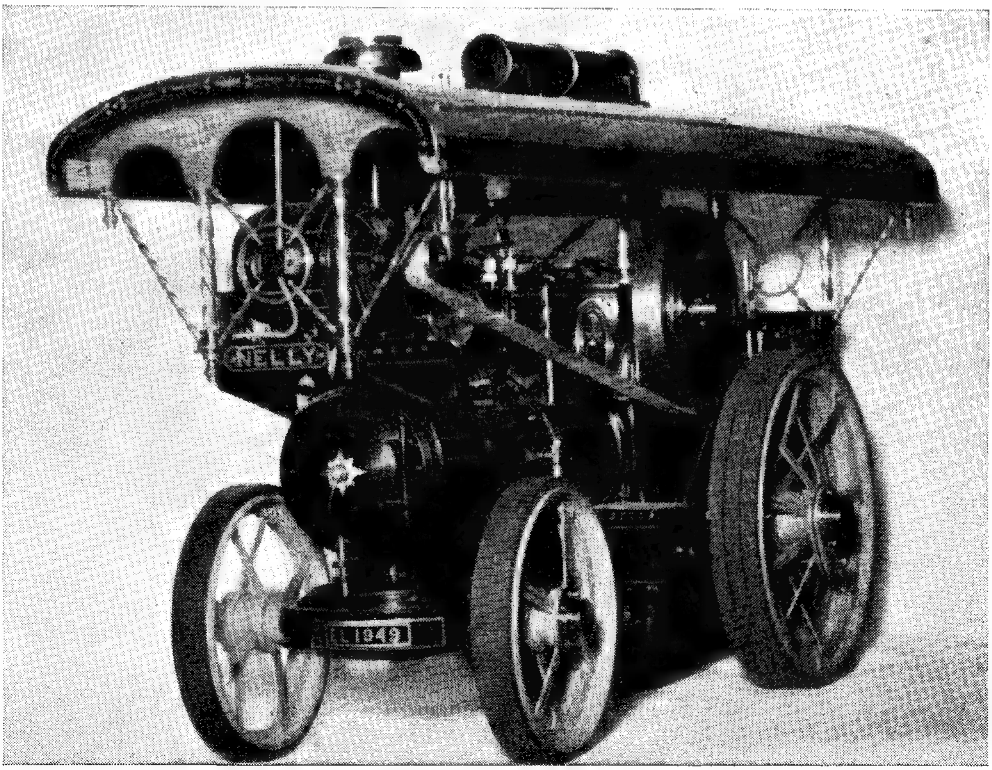
Off-side view of Mr. Lowe's locomotive



These pictures fail to do justice to the true excellence of this model



Near side of Mr. E. Lowe's showman's road locomotive, 1950 winner of the Grimsby Society's Championship Cup



Three-quarter front view

Novices' Corner

Making and Fitting Cotter Locks

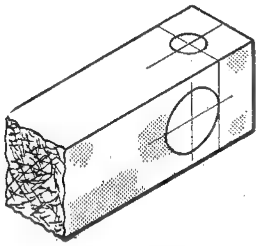


Fig. 1. Marking-out the work

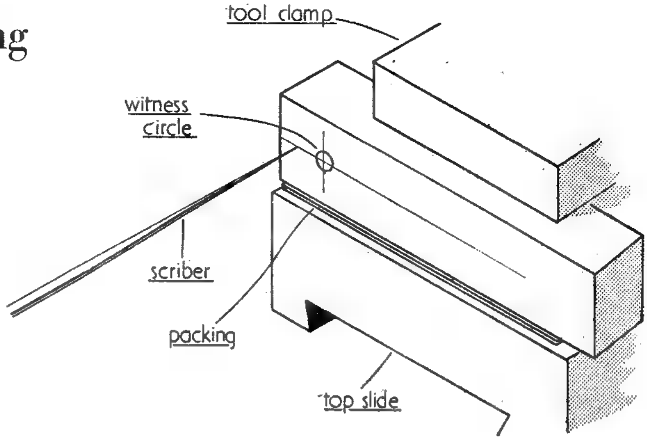


Fig. 2. Setting the work at lathe centre height

IN the previous article the common forms of cotter lock have been described. Their construction has also been dealt with in general terms. It is now proposed to give notes for making and fitting some of the various forms of lock, and in order to do so it will be necessary to refer to the illustrations which have already appeared in the previous article.

The three varieties of lock which were illustrated in Fig. 1B 1C and 1D of the foregoing notes have one point in common; namely, that the cotter is a well-fitting bolt that engages the shaft to the extent of half the bolt's diameter.

The need for making the two major components a good fit has already been stressed. Apart from the importance of this matter for the reasons given in the previous article, it is essential that no movement between the lever and the spindle or shaft should take place during the drilling and reaming operations on the cotter hole.

Machining the Bore in the Lever

The lever will need to be marked-out carefully, the centres for the spindle bore and the hole to receive the cotter being scribed as illustrated in Fig. 1. This is a straightforward operation requiring only a pair of Jenny calipers and a small square. After the centres for the spindle bore have been scribed, a circle the same size as the bore is drawn by means of a pair of dividers. At a tangent to this circle a line is drawn, as seen in the illustration, and is projected over the upper surface of the lever to serve as one of the centre-lines for the cotter hole. This part of the operation is carried out by means of the small square. The second centre-line for the cotter-hole is drawn by means of the hermaphrodite calipers.

The method used for holding the lever during the boring operation will, clearly, depend upon its length. If the lever is short, it may be mounted in the 4-jaw independent chuck for machining. Long levers, however, cannot be mounted in this way, for it would be impossible to swing them. The method usually adopted, therefore, is to catch the lever under the tool clamp of the lathe top-slide, having packed it to the correct centre height, and set the work square with the axis of the lathe.

Setting the Work at the Correct Height

Extreme accuracy is not usually raquired when setting work, such as a lever, to the correct height for machining. For all practical purposes, therefore, it may be aligned by means of packings until the point of a surface gauge, which has, previously, been set at the centre height of the lathe by reference to one of the lathe centres, registers with the scribed line on the axis of the lever, as shown in Fig. 2. Testing the work with the point of the gauge must, of course, only be done with the work clamped down firmly.

Setting the Work Square

The work may be set square with the axis of the lathe by aligning the face of the part to be machined with a faceplate mounted upon the headstock, as illustrated in Fig. 3A, or by means of a dial test indicator held in the chuck as shown in Fig. 3B. Those readers who are in possession of an " Eclipse " Magnetic Bas would undoubtedly use this piece of equipment to hold the Test Indicator, as it is a great time saver when setting up an indicator for test purposes.

After the lever has been set at the correct height and square with the axis of the lathe in the manner previously described, the point of a centre drill, which is held in the self-centring chuck, is brought into contact with the work and is set, by eye, at the intersection of the two centre-lines. The lathe is now set in motion

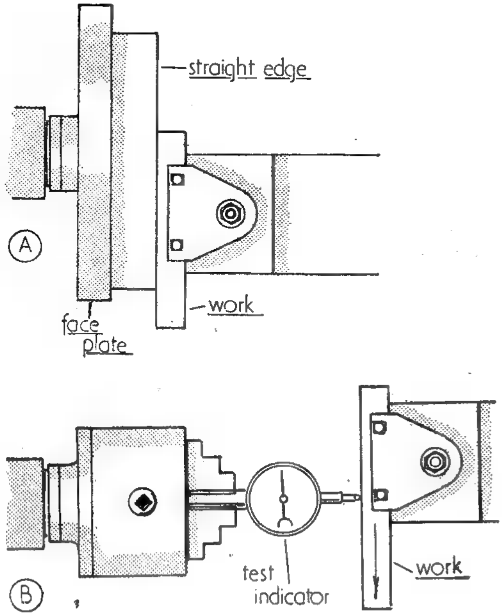


Fig. 3. *Two methods of setting the work square with the lathe axis*

and the work is fed to the drill momentarily. This will make a shallow drill mark on the lever, and from this it will be readily estimated whether the drill is properly aligned or otherwise. If the alignment is at fault, it may be corrected by setting over the cross-slide by means of its feed screw until further tests with the drill show the drill mark to be truly at the point of intersection of the centre-lines.

Assessment of the drill's alignment is greatly helped by the scribing of ■ witness circle $\frac{1}{8}$ in. diameter, as seen in Fig. 2.

After the alignment has been carried out satisfactorily, the cross-slide of the lathe is locked. The bore of the lever may now be machined, the sequence of operations being shown in Fig. 4. If the hole for the spindle does not exceed $\frac{1}{2}$ in. in diameter the work may be accomplished satisfactorily by, first, centre-drilling the lever, Operation 1, and following this with ■ pilot drill, Operation 2, after which the hole so formed is opened up to the correct size for reaming, Operation 3. A reamer is now mounted in the chuck and the work is then brought to size, Operation 4.

It must be pointed out that the use of ■ reamer in the self-centring chuck is likely to result in the hole being machined slightly oversize. However, this is of little consequence, for the spindle can, later, be made to fit.

Where the hole in the lever exceeds $\frac{1}{2}$ in. diameter a boring bar will be needed to bring the work to the required size; this is work which must be carried out in easy stages, the boring bar being held with the point of the tool ■ close to the chuck jaws as possible, so as to avoid excessive overhand and consequent whipping of the bar. The method is illustrated in Fig. 5.

Sawing the Slots in the Lever

The saw cuts, seen in Fig. 1B and Fig. 1C of the previous notes, may be made either with ■ hand hacksaw, or, in the case of Fig. 1C only, by sawing in the lathe. The work should be mounted and the whole operation carried out in accordance with instructions contained in the article "Sawing in the Lathe" which was published in the issue dated October 5th, 1950.

Machining the Spindle

After the lever has been bored to size, the end of the spindle must be turned so that it is an interference fit in the lever. An interference fit is one in which the male member is made larger than the female component, and the two parts have to be assembled together by force. It is, therefore, sometimes referred to as ■ force fit, ■ opposed to a sliding or ■ push fit, terms which are, themselves, self-explanatory.

The amount by which the male member is made oversize varies with its size and the duty which it is called upon to perform when the parts are assembled. In this instance an allowance of from 0.0005 in. to 0.001 in. will be sufficient to hold the parts together securely while the hole for the cotter is being drilled and reamed. It will, therefore, be necessary to ascertain the exact size of the bore in the lever before commencing any work upon the spindle. The most convenient, as well as the most accurate, method of determining the required dimension is by means of a taper mandrel, such has already been described in these notes, which may be used as ■ gauge. To obtain the dimension needed, the mandrel is pushed into the bore, so that it makes light contact with the work, and a mark is made with a grease pencil upon the surface

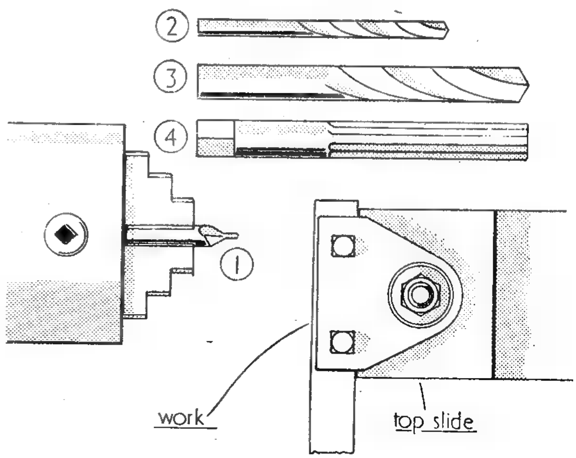


Fig. 4. *Sequence of operations for machining the bore of the lever*

of the mandrel [redacted] the place where the latter makes contact with the work. The mandrel is then withdrawn and its diameter at the pencil mark is measured with [redacted] micrometer. The reading obtained in this way will be the diameter of the bore in the lever.

Experienced workers [redacted] able, with a high degree of accuracy, to measure bores by means of internal calipers which are applied to the hole and are, subsequently, themselves measured with a micrometer.

This is an operation involving a transfer of measurement. It will be obvious, therefore, that much practice is necessary before any reliance can be placed upon results obtained in this way ; for much depends upon the worker being able to recognise that the feel of the calipers when placed between the measuring surfaces of the micrometer is the [redacted] it was when the calipers were applied to the bore.

Having determined the size of the bore, the spindle [redacted] now be turned to the correct interference fit, and the two parts assembled together [redacted] that the hole for the cotter [redacted] be drilled and reamed in the drilling machine.

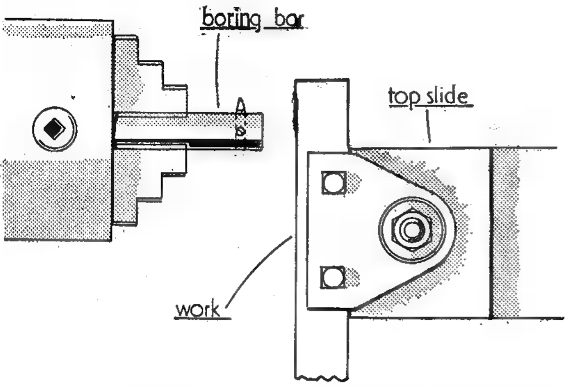


Fig. 5. Using a boring bar to machine [redacted] large hole in [redacted] lever

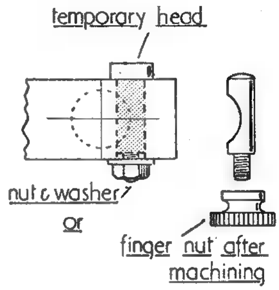


Fig. 6. Securing the cotter for machining

Making Half-Moon Cotter Locks

The work of making a half-moon cotter lock such [redacted] is illustrated in Fig. 2 of the previous article is, in some respects, similar to the operations which have just been described. In this type of lock, however, the cotter itself must be in place when the bore which houses the sliding member is being machined. Accordingly, the work is first marked out and the cotter hole is drilled and reamed in the drilling machine. The sliding member is next made, for it is essential to know the size of this part before machining the hole to receive it.

When the sliding member has been completed, the cotter must be made and fitted in place. It is essential that this part should be [redacted] firm fit, or it will move during the machining of the bore for the sliding member. There are two ways in which the cotter may be secured. In the first method, the cotter is made [redacted] press fit in its hole. Then, when the machining has been satisfactorily completed, it is removed and eased by polishing with emery cloth.

In the second method, the cotter is provided with [redacted] temporary head and is held in position by a nut and washer, as illustrated in Fig. 6. In this event, there is no need to make the cotter [redacted] tight fit. It should, therefore, be turned so that it is, from the commencement, a good sliding fit in its hole.

As will be [redacted] from the illustration, after the boring has been completed, the cotter is removed so that the temporary head may be machined away, and a knurled finger-nut is made to replace the original nut and washer should a fitting of this kind be desired.

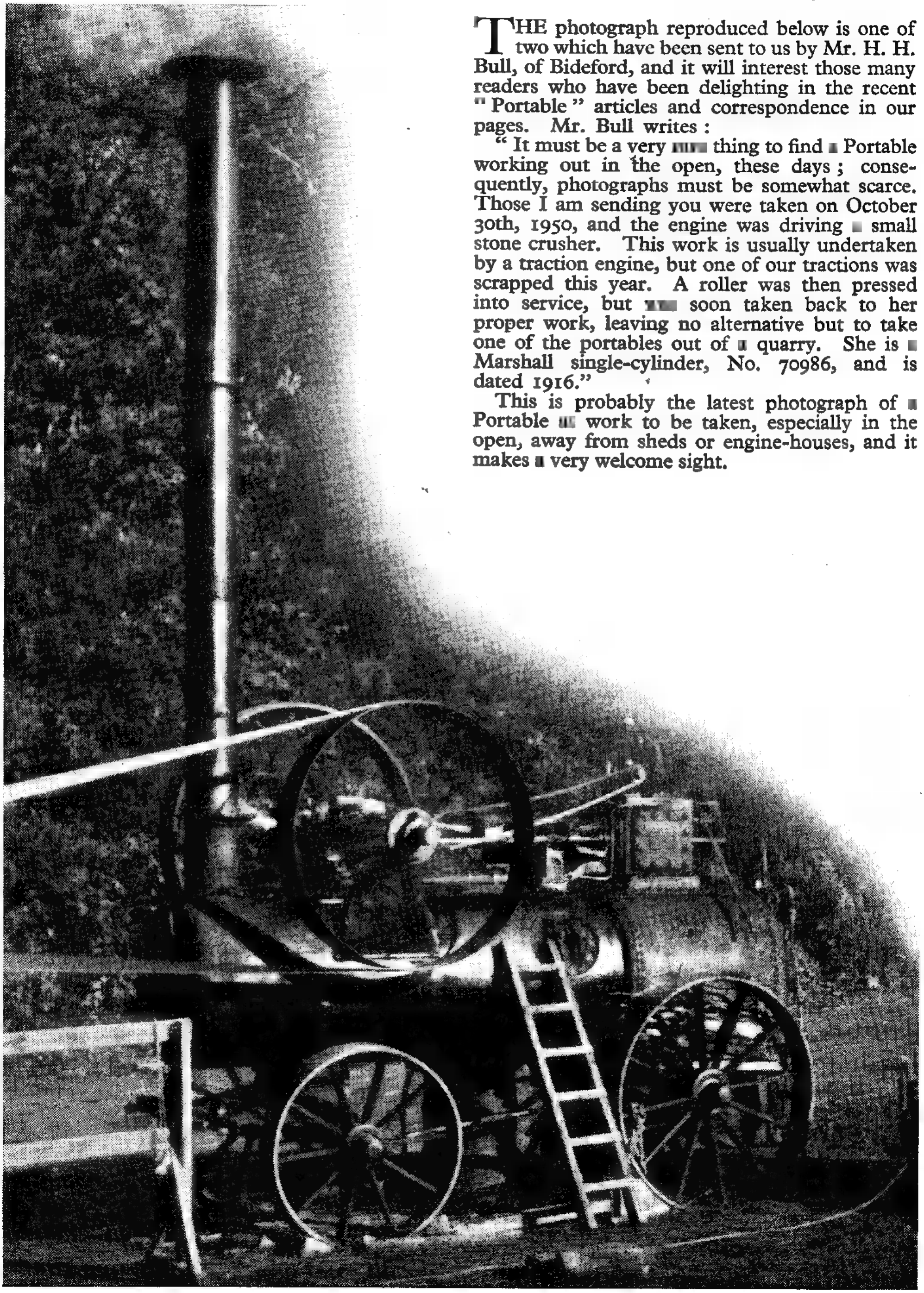
A Simple Flexible Coupling

Requiring a quick direct coupling between a ¼ h.p. motor and [redacted] *ex*-Government vane pump, both of which were fitted with ½-in. shafts, I mounted the motor and pump in line, and [redacted] rubber connection-piece, as used for domestic purposes on metallic gas tubing, was slipped over the two shafts. The connection-piece is slightly barrel-shaped, but when on the shafting, is pulled practically parallel ; the connection-piece being 3 in. long, the ends of the shaft were left ⅛ in. apart. A jubilee clip, fitted over the connection-piece at each end, completed the job.

This has proved so satisfactory that it has been left [redacted] permanent coupling. It is flexible, silent and appears to transmit the power without any undue stress. It looks as if it will last for years, and the cost was, of course, negligible.

—R. S. FARMER.

An Open-Air Portable in 1950



THE photograph reproduced below is one of two which have been sent to us by Mr. H. H. Bull, of Bideford, and it will interest those many readers who have been delighting in the recent "Portable" articles and correspondence in our pages. Mr. Bull writes:

"It must be a very [redacted] thing to find [redacted] Portable working out in the open, these days; consequently, photographs must be somewhat scarce. Those I am sending you were taken on October 30th, 1950, and the engine was driving [redacted] small stone crusher. This work is usually undertaken by a traction engine, but one of our tractions was scrapped this year. A roller was then pressed into service, but [redacted] soon taken back to her proper work, leaving no alternative but to take one of the portables out of [redacted] quarry. She is [redacted] Marshall single-cylinder, No. 70986, and is dated 1916."

This is probably the latest photograph of [redacted] Portable [redacted] work to be taken, especially in the open, away from sheds or engine-houses, and it makes [redacted] very welcome sight.

THE M.P.B.A. CLUB CHAMPIONSHIP 1950

by J. H. Benson

UPON the resumption of organised model power boat activities in 1946, attendances at regattas were somewhat poor, and it was proposed by the Orpington and Blackheath Clubs that some sort of " points " system could be awarded for attendance at regattas.

This commenced in 1948, and it was hoped that the scheme would help to increase the attendance at the various regattas and encourage interclub competition.

The scheme was as follows :—

Five events were eligible for points—Nomination and Steering, " A " " B," " C " speed events. A competitor entering any of these and completing the course scored 1 point for his club.

First place was awarded 15 extra points.

Second " " " 10 " "

Third " " " 5 " "

Some difficulty has been experienced by the Committee in deciding the winning club. In the 1948 Championship, the total points were divided by the number of affiliated members, but it was found that this unduly favoured the smaller clubs at the expense of the larger clubs, who might have many members affiliated but have only ■ few who are able to attend distant regattas. Subsequently, in 1949, the points were divided by the number of entrants, and the best average declared the winner.

Mr. F. Jutton, whose performances with *Vesta II* swept the board in class " B " for that year, easily secured the Championship for the Guildford Club.

It was felt by the Committee, however, that this result, although ■ magnificent performance, was not really ■ *club* effort and consequently decided that the 1950 result should be awarded on a number of different factors.

The accompanying table shows how the leading scorers fared. This table has been compiled from 15 regattas held under the auspices of the M.P.B.A. Unfortunately, difficulty has been experienced in getting full details of all the 1950 regattas, and clubs holding future regattas are asked to co-operate by taking ■ copy of the entrants and results. However, for 1950, only two regattas are not accounted for.

Upon consideration of the points scored, average points per entry, regattas attended, etc., it was decided by the Committee that the Orpington S.M.E., had put up the best show for 1950. In addition to the details shown in the table, nearly all of the power boat section of this Society run a boat in at least one regatta, a fine performance.

The table shows the most interesting scores, but it should be mentioned that over thirty clubs recorded some sort of score during the season.

The Committee of the M.P.B.A. would like to congratulate all clubs taking part in the championship, and solicit their support for future years, when it is hoped that even better results will be shown.

Highest Scoring Clubs
(in alphabetical order)

Club	Regattas attended	Total entries	Points scored	Average No. of points per entry	Total different craft at regattas
Bedford	3	26	55	2.11	7
Blackheath	14	111	274	2.46	18
Bournville	7	27	189	7	11
Coventry	5	11	32	2.9	3
Derby	5	16	70	4.37	6
Guildford	12	12	120	10	1
Kingsmere	11	83	266	3.2	20
Orpington	14	55	286	5.2	7
Runcorn	4	10	103	10.3	3
Southampton	7	25	96	3.8	9
South London	11	30	274	9.1	5
Swindon	5	14	68	4.85	3
Victoria	13	153	502	3.28	28

Queries and Replies

Enquiries from readers, either on technical matters connected with model engineering, or referring to supplies or trade services, are dealt with in this department. Each letter must be accompanied by stamped, addressed envelope, and addressed: "Queries Dept." THE MODEL ENGINEER, 23, Great Queen Street, London, W.C.2.

Queries of a practical character, within the scope of this journal, and capable of being dealt with in a brief reply, will be answered free of charge.

More involved technical queries, requiring special investigation or research, will be dealt with according to their general interest to readers, possibly by a short explanatory article in an early issue. In some cases the letters may be published, inviting the assistance of other readers.

Where the technical information required involves the services of an outside specialist or consultant, a fee may be charged depending upon the time and trouble involved. The amount estimated will be quoted before dealing with the query.

Only one general subject can be dealt with in a single query; but subdivision of details into not more than five separate questions is permissible. In no case can purely hypothetical queries, such as examination questions, be considered within the scope of this service.

No. 9893.—Generator for Arc Welding
K.W.K. (Leicester)

Q.—I recently purchased a generator to use for arc welding. I have managed to get a flash out of it, but not enough to maintain an arc. I would be grateful if you could supply me with a wiring diagram and advise me if there is any method of control of the voltage, etc.

R.—Arc welding in the accepted term cannot be carried out at a voltage so low as 29. 90-100 V is necessary and the arc voltage is usually 80, but this will vary with the nature of the work in hand, and also the electrode being used. A generator for arc welding is a special machine, not an ordinary dynamo; it has to have a particular characteristic which is carried out by compounding the dynamo in a certain way to give a certain performance. A higher voltage is usually necessary to strike the arc, and this voltage is reduced once the arc is struck. This is more or less catered for by the special winding of the dynamo. Other regulators are necessary in the circuit. It is not possible for you, therefore, to convert your generator to function as a welding generator.

No. 9891.—Rewinding an Induction Type Squirrel Cage Motor
A.S. (Bath)

Q.—I have recently obtained a 1 h.p. Brooks induction type squirrel cage electric motor in very good mechanical condition but of very old vintage. I intend rewinding it to give ¾ h.p. or as near as possible, and give below my calculations for the rewind which are based on the information given in "Small Alternating Current Motors," by A. H. Avery. I would be grateful if you would check them, and perhaps give me any further practical information to assist me. I intend using a "Twinob" switch for starting and running on a 15 A power supply. The data available is as follows:—

Stator laminations—bore 5.5 in., thickness 2.5 in.

48 slots—totally enclosed ⅞ in. long ¼ in. wide.

Rating ¾ h.p., 220 V, 50 cycles, 1-phase, 1,500 r.p.m.

Efficiency (from "M.E." handbook) 70 per cent.

Input watts required $\frac{746 \times 3}{4} \times \frac{100}{70} = 800$ watts.

Current at power factor of 0.7 $= \frac{800}{220} \times \frac{1}{0.7} = 5.2$ amps.

Wire to carry 5.2 amps., say 18 s.w.g.

Magnetic pole section $= \frac{\text{area of stator bore}}{4}$ (from book) $= \frac{5.5\,\pi \times 2.5}{4} = 11$ sq. in. (approx.)

Flux density 30,000 sq. in. Therefore, total flux per pole $= \frac{11 \times 30{,}000}{4} = 82{,}500$ lines per pole.

Total turns $= \frac{220}{4} \times \frac{100{,}000{,}000}{50 \times 4 \times 82{,}500} = 334$ turns (from book).

Starting coils = 167 turns 24-s.w.g. wire.

R.—We have checked your workings and they appear to be in order. It is noticed that you propose to connect this motor direct to the supply by means of a "Twinob" type of switch. As your motor may demand a current up to and over 30 A at starting, it will be necessary to see that the switch you use can carry this current also. A better plan would be to arrange for the starting winding with a condenser in series. This will improve starting conditions to advantage. A capacity of near 160 mfd. should be suitable, and having a working voltage of at least 400 V for intermittent use. If you wish to cut down on the cost of this condenser, you could connect the starting winding on half the running winding, when the starting winding will then operate at half the line voltage; in this case, you would calculate this winding for 110 V.

No. 9892.—Electric Irons
F. W. J. (Birmingham)

Q.—I should be pleased if you would explain the theory of the working of the heat control in an electric iron. I have put a new element in and set the regulator to low, then adjusted it as fine as possible with the adjusting nut. I get the circuit all right, but the lamp ($2\frac{1}{2}$ V, which I have tested to be O.K.), does not light, neither does the thermostat cut out when the iron gets too hot.

R.—The automatic heat control works on the principle of a bi-metal strip that expands as the iron heats. This is coupled to a movable contact that opens when the iron reaches a predetermined temperature, and the contact control is variable to allow different heats to be reached. Looking at the back of the iron there are three terminals, from left to right, 1, 2 and 3. The element tails are connected to 2 and 3, the shunt resistance to 1 and 3. The pilot lamp is also connected to these two terminals. The connecting lead is connected to 1 and 2. Terminal 3 should not have any hole in it for attaching anything. With your connections, the cutout should function, unless you have assembled the bi-metal strip upside down, and this can be checked by heating it, when you will see which way it bends.

No. 9889.—Rewinding a Motor
R.J.R. (Derby)

Q.—I have three queries relating to induction motors, and would be very much obliged if you would help me. I recently started to rewind a burnt-out squirrel cage motor (capacitor start, and run) 230-250 V, 1-phase, 50 W, horsepower unknown, but stator dimensions are 3 in. bore × $1\frac{1}{2}$ in., lamination pack. I found on starting the work that it was quite impossible to insert the stator coils through the small slots provided. After spending much time and trouble attempting to do so I decided to make the slots wider by carefully filing away. The slots were originally $\frac{1}{16}$ in. wide and I have opened them out to $\frac{1}{8}$ in. Could you tell me if this will have any serious ill-effect on the motor when completed? Is there any way of estimating the size of condenser necessary for motors of this kind when the original capacitance is unknown? I have a large number of ex-neon condensers of known voltage, but unknown capacitance. Would it be possible to wind condensers of any desired capacitance from these? I have in mind to strip a 1 mfd., note the total area of the plates and work from this figure, i.e. if I find by trial that a 1 mfd. has a total plate area of, say, 6 sq. ft. then to make a 0.5 mfd., I should require a plate area of 3 sq. ft. or for a 2 mfd. 12 sq. ft.

R.—You should not have experienced any difficulty in getting the turns in the slots, as the winding was put on in the first place. This style of stator is usually wound a turn at a time, but a complete coil may be wound, and the turns then pushed through the slot opening one at a time. If you mean that you cannot get a single turn through the slot opening, you must be using too large a wire, or too thick insulation. With the slot teeth filed out as you state, the motor is now practically useless for any amount of power; you will probably experience a fair amount of heating, due to the loss of iron here.

The size of a condenser for capacity starting cannot be calculated unless the inductance of the starting winding is known. As this will vary with the different makers' ideas, it is not possible to give any useful figure as a suggestion. The capacity will vary from anything from as low as 60 mfd. to up to 180 mfd. Also, the condensers used have to carry a high working voltage, not less than 400 V. With this style of motor, it is usual to feed the starting winding as a tapping on the running winding, the tapping being taken at the half position, that is, midway between two of the four coils. The reason why this tapping is made is to cheapen the cost of the condenser and keep its working voltage at a reasonable value. The winding of condensers is not a matter for an amateur; it requires a special technique and plant. Your best plan would be to parallel a number of condensers to obtain the capacity you may require, and this can be experimental. The condensers must, of course, be capable of a working voltage of not less than 400. Apart from the plate area, the thickness of the insulation between the plate matters, because as this thickness varies, so will the capacity for a given size plate.

No. 9882.—The Atomag Minor Magneto
D.A.R. (Dudley)

Q.—Will you please inform me if, in wiring the ignition coil for the above magneto using the layer winding method, there is any connection made between the core and the first insulated layer of the primary, between the primary and secondary windings, and between the insulated layers both in the primary and secondary. Will you also mention what the lowest possible revs. of the magneto are to permit sparking?

R.—It is not considered desirable, in the case of the particular magneto referred to, to connect the inner end of the primary winding to the core. As this end of the primary is earthed, the practice of connecting the wire directly to the core is quite common, but it has the disadvantage that, in making tests with primary winding, it is difficult to detect the presence of shorted turns in the primary. By leaving the wire disconnected and earthing it afterwards, tests for shorted turns can easily be made. The outer end of the primary is led out to the contact-breaker terminal and also connected to the inner end of the secondary. In both the primary and the secondary windings, the wire is continuous throughout the full number of turns in all layers. The Atomag Minor magneto will spark efficiently at 500 r.p.m., and as it is usually possible to turn small engines at approximately this speed over the essential period required to produce the spark, it will be found that quite easy starting is obtained with the magneto if other parts of the engine are in correct adjustment.

PRACTICAL LETTERS

Safety Measures for Model Steam Engines

DEAR SIR,—In answer to a letter in your issue of the 2/11/50, re the above, myself, like Mr. F. C. Gent, tried out Mr. S. W. Upjohn's method of running a model steam engine on bicarbonate of soda and tartaric acid, as instructed by Mr. Upjohn, but without results; so, like Mr. Gent, I would like to hear more of this method.

Yours faithfully

Devonport. J. C. DOWNEY.

Testing Lathe Slides

DEAR SIR,—I have read the several letters which have been written in connection with my article describing a lathe I made, and published in the issues of THE MODEL ENGINEER, dated October 5th and 12th, 1950. It would seem from the contents of these letters that I have made a slip as far as the aligning of the cross-slide goes.

Although it is some considerable time since I completed the machine, I have not had the occasion to machine a large surface, and on any job I have done, any slight inaccuracy of the cross-slide would not matter.

Since I have read the letters sent in on this subject, I have checked over the alignment and find that a very slight hollow about 0.002 in. deep is produced. Some time I will correct this.

I would thank these readers for their kind remarks and also for the trouble they have taken to point out this error of mine. The making of a lathe is always a large undertaking to anyone like myself who makes one for the first time and to his own ideas.

There must be a considerable number of finer, perhaps even not so fine, points about the production of a lathe, including the machining of parts and fitting them together that are not at all noticeable to the mere user of a lathe. I wonder if it is possible to get a real old-hand, say a machine-tool fitter to trade, to give us a few words on the subject in the pages of THE MODEL ENGINEER.

The number of fellows who have made a lathe and are actually still working on one must be considerable. If those who propose to start are added, then such an article would be well worth while. After all, lathe manufacture is a whole time job to some people, whose professional knowledge is confined to this, and nothing else. We amateur machine tool-makers would benefit, I am sure.

Yours faithfully.

Greenock. A. H. POOLE.

A Sturdy Veteran

DEAR SIR,—I was very delighted to see the photo. of the old 3½-in. Drummond lathe in the December 7th issue of THE MODEL ENGINEER.

I have one of these lathes which was bought by my father about 40 years ago, and it is in regular use by me.

It is in first-class order and has not had any part renewed; in fact, the scraping marks on the bed are still there.

I made all the turned parts of my "M.E." cine projector on it, which was awarded a diploma at the 1949 "M.E." Exhibition.

To make life a little easier, I altered the pulley grooves from 90 deg. to take a V-belt ⅜ in. size and fixed a Myford countershaft on a bracket on the wall behind the lathe to give a horizontal drive. I use a ¼ h.p. motor, and for short stops I use the lever to slacken the belt. This saves wear and tear on the centrifugal switch in the motor.

Yours faithfully,

Morecambe. ISAAC P. HOLDEN.

DEAR SIR,—With reference to the question underneath the photograph at the foot of page 883 in the December 7th issue of THE MODEL ENGINEER, I remember one of these machines being in use in the Handicraft Centre at Acton Central School. The machine in the photograph appears similar in all respects as I remember them. At the time that I knew the machine (1944) it was used as a drilling machine when students of Acton Technical College used the Centre. The tool holder was missing and had been replaced by a piece of angle-iron which acted as a table for drilling, the feed being applied by the leadscrew.

The only difference appears to be in the cross-slide; this was movable across the bed as in the later Drummonds. The machine was in very bad condition and it was not possible to use it for turning. The only point of which I was not aware was the swivelling headstock but, on reflection, I think that this was probably incorporated in the machine.

As far as I am aware the machine is still in use at the Centre, but I have no personal knowledge of it.

Yours faithfully,

Acton. E. SWEET,
G.I.Mech.E.

DEAR SIR,—I was very interested to see the photograph of the old 3½-in. Drummond lathe (page 883, December 7th, 1950) and to read the description, as I purchased a very similar lathe, even to the chuck on stand with treadle only last month. Apart from the absence of indices on handwheels, and the other refinements described on the lathe used by Mr. Chambers, the only difference I can trace on mine is in the slide-rest which is compound and has the T-slots on the lower slide running parallel with the bed, instead of across as in the photograph.

Although very dirty when purchased the lathe, after cleaning, turned out to have been scarcely used, there being no signs of wear on lead, or slide-rest, screws and nuts or on any running part. The only serious blemish is due to the stud holding the toolholder having been "pulled up by the roots"! Some of the bright collars and bosses were still free from rust when what appeared to be an original grease coating was washed off with paraffin, although parts which had been handled were rusty. In answer to a letter of enquiry, quoting the lathe serial number,

Messrs. Myford informed me that, although details were not available, these Drummond lathes with leadscrews in centre of bed were made prior to 1912.

It would be interesting to know what the original set of change-wheels was (there are nine with my lathe, but a 40-tooth at least appears to be missing) and whether the ¼ in. diameter leather belt has been found satisfactory when motorised.

Yours faithfully,

Oban. WM. E. MATHER

Radio-control of Model Boats

DEAR SIR,—Reading Mr. Harvey A. Adams's article on the above subject I notice he finds difficulty in remembering at which sequence the actuator is resting when using the Mercury-Cossor radio-control set.

I also have had this experience but have found a simple solution.

I removed the control knob and switch on the Mercury transmitter and replaced it with a second-hand telephone dial switch.

These switches are obtainable at surplus stores and *break* contact at intervals according to the number you dial.

I found it possible to alter the switch blades so that the action was reversed and the switch will make contact instead.

The boat always starts with the actuator in a pre-determined and marked position.

By dialling 1 the boat turns to starboard and dialling 7 centralises the rudder and also brings the actuator back to the original starting position.

Dialling 5 turns the boat to port and dialling 3 brings rudder and actuator back to starting position again. Forward gear is obtained by dialling 7 followed by dialling 1 when the switch has operated.

Reverse is obtained by dialling 3 followed by 5 to bring the actuator back to the starting position.

This can all be done by touch and the boat can be kept under constant observation. All that you have to remember is that each combination of numbers, adds up to 8 and the 8 position actuator will always return to the original position.

I find that thirteen distinct operations can be carried out with one winding of the actuator spring.

Delayed action switches on forward and reverse and a centralising switch on the rudder motor prevent unwanted manoeuvres as the actuator passes through the unwanted positions.

Yours faithfully,

Birmingham. A. M. SMITH.

CLUB ANNOUNCEMENTS

The Society of Model and Experimental Engineers

The annual general meeting of the above society will be held at 2.30 p.m. on Saturday, January 20th, at Caxton Hall, Westminster.

Hon. Secretary: A. B. STORRAR, 67, Station Road, West Wickham, Kent. Springpark 3027.

Glasgow Society of Model Engineers

The next meeting will be held on Saturday, January 20th, at 7.30 p.m. This will take the form of a discussion relative to the opening of our railway track, rolling stock, track events, competitions, running topics.

To celebrate the thirtieth anniversary of the founding of the society, a film show will be given on January 27th, at 7.30 p.m., by Mr. Ian Burdon, M.B., Ch.B., F.R.C.S. Come along and meet the veterans who built Glasgow S.M.E.

The clubrooms, 60, Clarendon Street, Glasgow, N.W., are open Thursday, Friday and Saturday from 7.30 p.m.

Hon. Secretary: ALLAN RODGER, 93, Ormonde Avenue, Muirend, Glasgow, S.4.

Romford Model Engineering Club

The following meetings will be held at the Lambourne Hall, Western Road, Romford, commencing at 8 p.m.

January 18th. Annual general meeting.
February 1st. Competition night.
February 15th. Film show (sound).

Hon. Secretary: C. WILKINS, The Lodge, Woodward Road, Dagenham. Tel.: Rippleway 2871.

Torbay Society of Model Engineers

We have had a grant of land from the Corporation of Torquay at Walls Hill. There we are making a miniature railway of 5 in. gauge down to 1⅞-in. gauge and we are going to make a circular boating pond for sailing, steam and electric boats.

We shall be glad to meet any model engineers in the Torbay district who may care to join us.

Hon. Secretary: F. H. BEYNON, 107, Ilsham Road, Torquay.

Grantham Society of Model Engineers

During the latter part of last year, members of the above society paid a visit to the Myford Engineering Company's works at Beeston. We were royally entertained by Messrs. Moore and Barrs, and members of their staff, a comprehensive tour of the works being followed by an excellent tea and a general chin-wag.

Our second exhibition has already been reported in THE MODEL ENGINEER dated November 23rd, 1950. All concerned in the organisation and running of the show feel justifiably pleased with the results, especially from the publicity angle. Whispers have also been heard in certain quarters of what may be produced in 1951.

After some lengthy negotiations, the society has absorbed the local model aircraft group, the "Grantham Zoomers." Our united strength is now 58, and we are affiliated to both the S.M.E.E. and the S.M.A.E.

A dinner was held on November 30th, after which exhibition awards were distributed by our vice president, Mr. G. F. Johnson, Principal of Grantham Technical College. A programme of films followed, presented by Mr. J. F. Traxler (member), whose selection demonstrated the advances in technique from early Chaplin comedies to modern colour photography.

Hon. Secretary: S. L. REDSHAW, 47, Rookery Drive, Alma Park, Grantham, Lincs.

Tonbridge Model Engineering Society

A general meeting was held recently, with Mr. H. H. Mills in the chair. Eighteen members and several guests were present.

A talk by Mr. R. R. Turner on his recollections of locomotive types and performances was much appreciated.

Mr. Roy Procter and Mr. C. C. Langer then showed films of the society's track, and other items of particular interest to model engineers, and the chairman concluded the meeting with a hearty vote of thanks to these members.

Hon. Secretary: R. H. PROCTER, M.I.Mar.E., Roslyn, Coldharbour Lane, Hildenborough, Kent. Tel.: Hildenborough 2304.